THE INDUSTRIAL ART

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THE INDUSTRIAL ARTS

THEIR HISTORY, DEVELOPMENT, AND PRACTICE AS EDUCATIONAL FACTORS

By

FREDERICK J. GLASS

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PREFACE

For some years I have felt assured that the hand is quite as important as the brain in the education of the child. In 1920 I published *Drawing, Design, and Craft-work* with a view to stimulating interest in these subjects as educational factors. The book was perhaps a trifle premature for only recently has a second edition been called for. The present work is the outcome of a number of articles contributed to the *Times Educational Supplement*. In 1925 the editor requested me to write and illustrate a series of articles for that important periodical. I undertook the task with alacrity, realizing how influential was that organ in the teaching profession. The following year I was asked to contribute a further series, from which I concluded that the previous set had not been altogether unsuccessful. A number of enquiries from various places at home and abroad, as to whether the articles were to be published in book form, induced me to amplify them into the present volume. I have delved into many books, have "ransacked the ages, and spoiled the climes" in search of material. The only books which I could discover dealing with the subject as here treated, hailed from America. As far as I am aware this is the first English book to be published which treats of the Industrial Arts as a basis of education. Yet it is a form of education, or a method of approach, which is bound to be exploited to a far greater extent in the future than has been the case in the past. Although there is no reason to believe that education in England taken as a whole is less efficient than it is in other countries, there are reasons for thinking that in certain of the newer aspects of education she has shown less enterprise than some of

her neighbours. This is one of them—this attempt to enlist the hand in the service of the mind. For the system here advocated is not new. It has been in vogue in other countries for some years and it is only a matter of time for its value to be recognized in this country as well. The combination of hand and brain, of motor with mental activity, is calculated to produce better results than when the brain alone is exercised. Thought, design, and execution in some tangible mediums are combined in logical sequence, while the excursions into history, geography, arithmetic and science, which grow out of the lessons, are invaluable to the expansion of the child mind. My thanks are due to the proprietors of the *Times* for allowing me to utilize the material published in the *Educational Supplement* and also to the *Doncaster Gazette,* in which paper some of the drawings have previously appeared. To Mrs. Radice in particular I am indebted for the help and encouragement afforded during the preparation of the articles upon which this book is based. I can only hope that my efforts will prove useful to the teaching profession generally, and will assist in bringing the Industrial Arts into their proper place in the educational system. As to their importance in the training of the generations to come, I have no doubts whatever.

FRED J. GLASS.

DONCASTER, 1927.

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INTRODUCTION

THERE are many theories regarding the aims and methods of education. Some people clamour for efficiency in commerce or industry, others claim that in a knowledge of the "Classics" lies all that is necessary, others again would confine the curriculum to reading, writing, and arithmetic, while to the hedonist pleasure is the highest goal. There is something to be said for each of these theories (especially by their respective advocates), but individually they lack that breadth of outlook which should characterize the ideal system of education. Aristotle says that "The end of man is an activity," and surely mental and motor activity combined is the greatest happiness known to man, because it allows full play to the creative instinct, wherein lies the loftiest and most complete expression of himself, and all that he was born to be and do. Social efficiency is a better and broader aim than commercial or industrial efficiency. An education which prepares the future citizen for taking his part in the multifarious activities of social life, and enables him to give of his very best for the benefit of his fellows, at the same time getting all the good it is possible to obtain for himself, is surely one to be desired. Happiness does not come to those who seek it for themselves, but rather to those who seek it for the community. This is where the hedonist theory is weak. Thought did not cease when Greek and Latin became dead languages, neither did man suspend his activities, hence the failure of the Classic theory. Reading, writing, and arithmetic are simply three vehicles out of many for the conveyance of knowledge, and taken all together they are still incomplete. All that the human race has thought, experienced, and expressed are not

contained between the covers of books. Consequently we must seek a wider field than either of these theories afford if we would educate our boys and girls thoroughly. All of them combined with other ingredients will perhaps help us to formulate a comprehensive scheme. There is one very important factor which has long been ignored, or only of late been partially recognized in educational circles. This factor is the art and craft work, which has been produced from prehistoric times, all down through the ages, in every clime, and by every race, even unto the present day. A large proportion of the population of the world is still engaged in such work and yet our scholastic authorities seem not to be cognisant of the fact. The vast potentialities which lie in this direction for the inculcation of knowledge, and for the development of thought, and of manual skill have not as yet been exploited to any extent. Unfortunately it is only too common to regard the work done for a livelihood as a necessary evil. Too many of us work to live, rather than live to work, yet "Man findeth no joy save in the work that he doeth under the sun."

The craftsman has been looked upon as inferior to the professional man, and even to the clerk or the shopkeeper, whose work is of far less import in the world. The man who actually constructs or creates is surely of greater value to the community than he who tabulates, classifies, or distributes the articles made by the craftsman. It would seem that the man who dirties his hands or is constrained by his occupation to appear other than spick-and-span must needs be placed in a lower social strata than another who is always clean and tidy, no matter how useless he may be. This is assuredly a wrong estimate, and the sooner it is replaced by a saner one the better for society generally. We must recognize and acknowledge the dignity of labour, and not attach so exaggerated an importance to the tailor's handiwork. All down through the ages we can hear the clang of the craftsman's hammer, beating out the destiny of the race, and it needs but little imagination

to hear the reverberations ringing on into the future until in due time that destiny is fulfilled. How such a low estimate of the craftsman as that which prevails ever crept into vogue is difficult to imagine, for in the days of the Guilds a certain dignity was attached to the skilled workman, while during the Renaissance such men as Benvenuto Cellini and the della Robbias were fit company for popes and princes.

In those days, however, artists were craftsmen and craftsmen were artists in the true sense of the words. The artist was not of necessity one who did naught else but paint easel pictures, or carve statues. He painted, modelled, carved, designed, and worked in metals. He ground his own colours, prepared his own materials, and even did his own bronze casting. Benvenuto Cellini in his *Autobiography* gives a most entertaining account of the methods he employed and the difficulties he overcame when casting his "Perseus." The story is very human, told as it is with all the naïve egotism which characterizes the memoirs of this rascally though skilful craftsman. In fact the whole book is really a vivid picture of the life and thought of sixteenth century Italy, but it needs to be read in the spirit of that period. The fastidious moralist of to-day might well be shocked unless he brings to the book that tolerance which is born of a broad outlook, and a wide sympathy with human frailties. He must realize that ideas of morality change, and that to-day's standard is not applicable to the age which produced Machiavelli's *Prince* or Boccaccio's *Decameron*, though the same age gave birth to Savonarola, sending him finally to the stake, however, because of his idealism, and his belief in a goodness for which as yet it was unprepared. Benvenuto and his fellow craftsmen were men of importance and the work they did was appreciated and admired by those about them. This was something in favour of the age, for it proved that beauty was desired at least as much as wealth.

Nowadays the skilled craftsman ranks far below the opulent stockbroker or the grasping moneylender,

though his work is infinitely better for the community. It would seem that an utterly false standard of values lies at the root of this discrepancy, and the sooner it is changed the better for mankind. This change can only be brought about by beginning with the children, who should be taught to realize the dignity of honest labour and the real worth and beauty of fine craftsmanship. A wider and fuller use of art and craft instruction in every type of school is calculated to produce the desired result. Most people need to be able to use their hands intelligently and skilfully, and the manual arts assist in developing facility in handling tools and materials, together with vocational powers. They give a first-hand knowledge of industrial products, and of the things which go to make up the environment.

History is written upon craft and handwork more distinctly and correctly than upon the pages of many books which are termed historical. A knowledge of the language is needed before it can be deciphered, however, and lessons in the manual arts will give a command of that language. They lead to an added appreciation of beauty in form, colour, tone, texture, and technique, besides being a means of transmitting from man to man, and from age to age, some of the finest and purest thoughts and feelings that the race has known or experienced. This claim is not an exaggerated one, though to the superficial glance it may seem to be. Surely, then, here is sufficient reason for including the manual or industrial arts in our schemes of education. "Man only understands thoroughly that which he is able to do," says Froebel, to which may be added, "The eye only sees that which it brings the power to see," for the two aphorisms help to explain each other. The actual making of a thing leads to an appreciation of the tools and materials employed, and of the craftsmanship involved in its construction. This appreciation gives an added power to the eye to see in another similar thing such qualities as may be common to both. By seeing, we mean a clear mental grasp through the medium of

the eye, and not a mere superficial glance which leaves no impression on the mind. The habit of looking without seeing is only too common, for it needs some little effort of concentration before a tangible idea of anything can be grasped and retained. A painter expresses his thought and feeling by means of his pigment, and because of his power of expression he can better appreciate the thoughts and feelings similarly expressed by other painters. The same applies to every art and craft. We can only grasp the finer qualities of literature when we have ourselves tried to write. Music makes a stronger appeal if we have studied the technique, while the peculiar characteristics of metalwork, jewellery, wood, and stone-carving, cabinet-making, textiles, architecture, and every other art or craft will reveal themselves only to those who have actually been engaged in them. Some who would fain be considered cultured, read lengthy, verbose criticisms, and adopt much technical jargon, but it remains very doubtful whether their appreciation is genuine, or their knowledge more than superficial. Again, many people buy pictures because the scenes or objects depicted interest them, whereas if they knew anything of the art of painting they would not vouchsafe a second glance. Real appreciation necessitates definite knowledge of the art, as it involves feelings which can only come through actual experience. A study of processes, methods, motives, relationships, and the work of other craftsmen will greatly enhance our faculty for appreciation.

Thought and enquiry, stimulated and rendered concrete by motor activity, is calculated to make a deeper impression, and to give a clearer grasp of the subject than will any book or lecture, however illuminating it may be. The lessons are primarily cultural and only incidentally vocational. Familiarity with a number of crafts is vastly preferable to expert skill in one only. There should be no attempt to turn out artists or master craftsmen, but rather to educate the pupils to a certain degree of proficiency in mental and motor activity,

together with the capacity to discriminate and appreciate. The value of the lesson cannot be estimated by the neatness and finish of the work produced, nor should the work be compared with machine-made products. The real worth lies in the thought involved in the planning of the object, in the speculations and enquiries into the tools and materials involved, and the purpose the object is intended to serve; in studying its relationship to other articles and processes, together with the history and development of tools, methods, and materials, and their origin and distribution. There is a wide field for thought opened out in the consideration and practice of any craft, while the manual exercise involved is invaluable in impressing upon the mind the information acquired during the process. Skill and confidence in handling implements and materials will naturally follow.

We do not fully realize the value to the community of a healthy, happy, efficient human being or there would be fewer attempts made to fit square pegs into round holes, to use an apt though somewhat hackneyed simile. Many young people (and older ones, too, unfortunately) are perplexed and unhappy because they are forced into occupations for which they are totally unfitted. They do not understand what they are doing, they have no mental grasp of the process they are engaged with, and they fail to realize or visualize the whole of which they are producing a part. A more comprehensive idea of the work they are doing would tend to increase their interest and consequently their zest and happiness in their daily task. If such knowledge is not acquired outside the factory, it is doubtful whether it will be inside, for the standardization of parts and the system of producing them in separate departments, to be finally assembled in still another, tends to narrow the interest and to circumscribe the knowledge of the operatives in the various departments.

It is a moot point whether the introduction and spread of machinery has proved to be the unmixed blessing we fain would believe it to be. It is perhaps

too much to ask for a return to earlier methods when the craftsmen and their apprentices carried a task through from its initial inception to its ultimate finish, but we can hardly doubt that such methods produced more skilled and confident men, who found greater joy in the work they were doing, than do our modern factories. Instead of finding joy in work nowadays we clamour for shorter hours and more leisure, when, unfortunately, the leisure hours are too often hours of boredom and even of mental and moral laxity. We may not be able to alter the system which obtains, for undoubtedly this is an age of commerce and mechanism, but we can at least help towards a greater knowledge of industrial processes and a corresponding increase of interest and joy in the daily task, at the same time providing useful and absorbing occupation for leisure periods.

"The human hand is the tool of tools," says Aristotle, and there is no gainsaying the truth of his statement, for all tools whatsoever are useless without the human hand which they serve merely to reinforce. Tools, however, help to give man a greater mastery over Nature and her products. "Man is a tool-using animal," says Carlyle, and it is undoubtedly his capacity for handling tools which gives man the ascendancy in the animal kingdom. All machines and scientific apparatus are but refined and improved tools which can be traced back to a simple origin, and the improved tool demands a greater skill in the hands of the craftsman. Rough work calls into play only the larger groups of muscles, while finer work exercises smaller groups and develops the more accurate motor functions, because it requires a finer adaptation of the muscular movements. It is essential then that handwork should commence early in the child's life if we would achieve the best results. It should, in fact, be linked up with the child's play even before the school period, and should certainly be practised during the earliest school years, while in the after years it must never be neglected. Needless to say the exercises should be carefully graded from "The

easy to the difficult, the larger to the finer." Otherwise too great a tax is placed upon the capacity of the child, who becomes discouraged and exhausted. The development of the individual runs parallel with the development of the race, and in the gradual increase of difficulty in the exercises we are following the evolution of the craft itself.

It is interesting to note that most people are right handed, and despite many efforts to develop the left hand as well, there still remains a natural preference for the right. It is assumed that the spoken language and the control of the right hand are both centred in the left half of the brain. Hence it would appear that a sort of sympathy exists between the speech centres and those which control the movements of the right hand. At any rate we know that dexterity of hand does assist in the development of speech, while handwork is undoubtedly a form of intellectual training. There are very few children who are not industrious, willing, and attentive, provided they are interested, and are doing what they wish to do. It rests with the teacher to so arrange the lessons that interest and enjoyment accompany the work.

Another aspect of this subject which is worth consideration is the relationship of teacher and pupils. At one time it was deemed essential to good discipline that the teacher should never descend from the dais, but should hurl his facts and figures at the heads of his class like Jove distributing thunderbolts. The outcome of this was that the pupils stood constantly in awe of the teacher, whom they feared, and regarded more as an ogre than as a mentor. Such an attitude argues a state of doubt and fear on the part of the teacher as well as on that of the pupils. He doubts his power to control the class as soon as he allows the least latitude. He fears for his own prestige and importance as a pedagogue. The distrust of the class which such an attitude implies can hardly have been salutary or productive of good feeling.

It is well to know that this state of affairs is gone, or rapidly going, and that teacher and pupils are on much more agreeable terms. The instructor guides and assists rather than dictates and commands. He leads the children to think for themselves, to enquire, to investigate, and as far as possible to find their own solutions, instead of bombarding them with information for which they are quite unprepared, and consequently have no use whatever. History is no longer a list of dates and incidents which, being quite unrelated to anything within the experience of the child, lacks meaning, coherence, and interest, but is an enquiry into the tools, methods, and activities of bygone peoples rendered more intelligible because of the child's own efforts to work along similar lines. The children learn to respect the superior skill of the teacher, and are grateful for the assistance he is able to afford out of his wider knowledge, and the very fact that he talks less than his predecessor will give his words greater weight. The teacher helps the children to enquire and to investigate, he guides them in their labours, and when they have exhausted their own initiative, he assists them to go yet a little further. The whole system resolves itself into developing self-reliance in the pupils and helping them to perceive, to reflect, and to retain what they have grasped. Further, it provides a bridge between school and after-life, spanning the gulf which has so long separated the two periods, and allowing the young people to slide imperceptibly from one into the other. Rousseau contends that one hour's work will teach the pupil more things than he can retain in his memory from a whole day's explanation, which contention is incontrovertible.

A sound training in handicrafts and manual art inculcates the habit of work in the truest sense of the word, for it cultivates thought and investigation, leads to a careful and æsthetic planning of every project, an appreciation of the characteristic qualities of materials, of the purpose each object is intended to serve, and of all that has been accomplished in each particular craft.

All this is driven home by the actual making of the thing planned, investigated, and studied from every aspect. Surely the hand is worthy of a place of honour, beside thought and speech, as it helps to raise man above the condition of the animal.

Psychological research has led to the conclusion that intellectual development is dependent upon the development of the senses, and the muscular system particularly upon the training of hand and eye. Our modern industrial system with its complex and elaborate mechanical contrivances has robbed the operatives of any opportunity for actual productive work, and this must be compensated for by instruction from other sources. Otherwise there is a danger that the workman will degenerate into a mere unthinking, industrial automaton, which, considering all the splendid potentialities that lie within the brain, and the complex organism of the human being, is sheer criminal waste. The man who is engaged in any task, even the most menial, should be conscious of the fact that he is serving the community, and should be allowed to share with his fellows opportunities for culture, and for enjoying the best which life has to offer. No section of the populace has any right to monopolize the benefits or joys which are the heritage of the race, and which are ours simply because of the activities of our forefathers. The pleasures of the arts, of craftsmanship, music, literature, and all that helps to raise man above the earth do not belong exclusively to the rich, or to the favoured few. They are priceless indeed, being above the power of money to purchase, yet they lie within the reach of all, given the faculty to appreciate, and it is this faculty, this power of intellect and æsthetic sensibility, which the teacher endeavours to unfold and cultivate.

The science of common things, if we may use the phrase, is becoming a fundamental factor in modern education. Intellectual insight into the wide relationships of the industries, deeply impressed by means of actual practice in the industrial arts, gives a fresh out-

look upon, and an added value to, subjects like history and geography. The lessons in woodwork will combine enquiries into the history and development of tools, and examination of wood and its sources, including types of trees, lumbering, transport, sawing and seasoning, together with the history and methods of woodwork. Iron is traced from its original state as ore, through the various processes to the highly finished article of steel. The enquiries involved will lead the scholars to many parts of the world, helping to render the geography lesson clearer, more tangible, and vital. History is unfolded as the evolution of methods is traced through each epoch and phase of civilization. Constructive history, too, rather than destructive. It is of the men who made things to add to the world's treasure store that we learn in this manner, men who planned and wrought, laboured and spent themselves, in the service of mankind, rather than of warriors and conquerors who devastated and destroyed in order that they might gratify their inordinate lust of pomp and vanity.

In addition to these things, there is the æsthetic element, a most important factor in any scheme of education which aims at the full development of mind, soul, and body. The pupils should be taught to appreciate beauty and fitness from the very outset, and throughout the whole course of instruction. The æsthetic element is indispensable in all creative work because it ensures a sound basis upon which to build, and is calculated to save us from the vulgar ostentation which for commercial purposes is blatantly labelled "Art."

Fitness for its purpose, together with a due recognition of what is sane and suitable for tools and materials, is the fundamental basis of beauty. The scholars should be encouraged to think out their exercises along these lines, as the standards of taste and discrimination so acquired will be of inestimable value in after years. If the children of this generation are grounded in the principles of æsthetic judgment and discrimination there

can be no room or toleration for ostentation, vulgarity, or shoddy pinchbeck in the next. If the lesson is to be fully exploited, the children should think out their own designs. The creative faculty must be allowed full scope from the inception of the project to the finish thereof. Thus shall we produce thinkers as well as performers. Thought without expression is fruitless, while the expression of another's thought is cramping and debilitating. The difficulty lies in cultivating taste and sensibility. The desire to create is inborn, but unless a standard of taste is inculcated the creative instinct is apt to squander itself upon work which is of little if any value. In each problem we have three valuable thought ingredients—the æsthetic conception and planning of the work, the construction and technical execution, and the knowledge of tools and materials.

There are three methods of teaching at the command of the instructor. The Imitative, the Discovery, and the Inventive. Let us examine these for a moment in order that we may compare the peculiar advantages of each. In the Imitative method the teacher shows the pupil how to do things by doing them in his presence, explaining the process and the reasons for each step as it is taken. This is a quick and an easy method, as children imitate readily. The Discovery leaves more to the child, who is encouraged to find out for himself. Examples, apparatus, materials, and a suitable atmosphere are provided, while the inquisitive child examines and imitates, finding out as much as possible. When he has exhausted all his ingenuity, it is time for the teacher to suggest, to explain, and to help the child towards a fuller understanding and appreciation. The Inventive method commences with the need for a certain article intended for a particular purpose, which purpose is kept constantly in view during the design or invention of the article. The method of production is then thought out, together with the tools and materials to be employed.

There is something to be said in favour of each of these systems, but the Inventive seems the most rational

in theory, though it might profitably be combined with the other two. From the æsthetic standpoint, however, it would appear to be the soundest, as it starts with a need, and then endeavours to supply that need as logically and as suitably as possible, with fitness for purpose as the guiding principle. The grading of the exercises according to the age and ability of the pupil is of course an important matter, so too is the continuity or sequence of the problems undertaken.

In arranging a course in the industrial arts the teacher has a well-stored treasure house of historic material upon which to draw, and every example has been evolved out of a long series of experiments. Further, each particular method of construction is to a large extent typical and will recur constantly throughout the whole succession of exercises in any single art, while there is a good deal which is common in the technique of all the crafts, serving to bind them all together. So that in learning one craft we are preparing the way for other crafts. It is hardly to be expected that the children will achieve a high degree of proficiency in any art, let alone two or three such arts, or crafts. The end in view is not this, so much as experience in inventing or designing, in the use of tools and materials, and with the typical thoughts and constructions which control a few universal arts.

To put it briefly the thought content of the industrial arts, properly treated as a school subject, includes direct contact with materials and a knowledge of their sources, qualities, and uses; actual experience with tools and implements with a knowledge of their underlying principles, and science of handling; a knowledge of constructional devices and technique, and of the governing principles based upon materials and needs; an acquaintance with such industries as are closely related to the industrial arts practised in the school; a knowledge of the relationships which exist between the industrial arts and the natural sciences, geography, and history; knowledge of the fundamental principles of good taste,

and of that finer fitness for purpose and perfection of conception which raises craft work into the realm of art. This involves a study of the history of art and of the canons of taste and design.

The æsthetic element is important as it helps to raise the work from the level of manual exercises into the realm of creative art. It may be claimed that the æsthetic principle does not enter into the crude immature work of the child, but if art is self-expression, to be measured by the evidences of thought and feeling, this contention is scarcely tenable. It is all a matter of degree, for in its own primitive way the work of the prehistoric artist is quite as much art as a modern picture, possibly more so in many cases. The child seeks expression for its desire for beauty by drawing and colouring, by making toys and playthings, in acting and impersonation, and in games of make-believe. In such activities we see the child imitating the people and the things about it, from which it would seem that the environment is an important factor in education, and hence the more beautiful that environment the better for the child, and also for the race. It is inherent, this desire for beauty, this urge towards æsthetic expression. It is universal, so we must not be surprised if it evinces itself in the child, rather should we be disappointed if it does not. It has played its part in the evolution of the race.

> "A fire mist and a planet,
> A crystal and a cell,
> A jellyfish, a saurian,
> And caves where cave men dwell;
> Then a sense of law and beauty,
> And a face turned from the clod.
> Some call it evolution,
> And others call it God."

Another aspect of the subject is the effect that training in the industrial arts is calculated to produce upon the markets of the future. Children in whom the æsthetic sense has been cultivated will be less likely in after years

to purchase ugly or unsuitable articles than will others who have had no training whatever. This will react upon the standard of the work produced by our manufacturers, who will no longer be able to turn out shoddy stuff because there will be no market.

Again, quite a number of the children who are being taught to-day will in a few years' time be actually engaged in some trade or industry upon which the lessons under notice will have a direct bearing. In consequence they will enjoy their work more keenly, and the joy they feel will be evinced in what they do, to be again experienced by others who see their work. It can scarcely be claimed that modern industrial conditions are altogether ideal for those who are engaged therewith. Too often there is a soulless monotony and an endless repetition which can only warp and stunt the minds and personalities of the operatives. They are not designers of wholes, but makers of parts, and because of this the workman himself is too often careless and inefficient.

To develop and to utilize an educational influence which is calculated to raise the common task of man above the level of mere drudgery, putting a new meaning and vitality into his labours, is surely worth any man's while. It is with this end in view that the present book has been written in the hope that teachers will be stimulated to think out their own schemes of instruction in the industrial arts.

THE INDUSTRIAL ARTS

CHAPTER I

SHELTERS

We know very little about primitive man. We do not know exactly when or how he commenced to erect shelters for himself and his family as a protection against the elements, and the beasts of prey which menaced him. But we assume, reasonably enough, that in addition to food and clothing, some form of shelter was necessary, and so was early sought and found.

Caves. Caves we know provided some of these people with habitations, and we know also that they decorated the walls of these caves, proving thereby that they had needs over and above mere bodily ones. They were seeking a mode of expression for thoughts and emotions which in due course, in the evolution of the race, were to expand and deepen into those which have inspired all that is best in the products of mankind. A vast gulf would seem to stretch between these early cave decorations and bone scratchings, and the work of Michael Angelo, Titian, Shakespeare, Dante, Corot, Turner, and all the other great ones who have added to the beauty in the world. But the same desires, the same hunger for the expression of moods and aspirations, inspired each and all. But even the broadest and deepest river has its source in some small bubbling spring, hence there is no cause to wonder at Art's crude, archaic origin.

Huts. The same urge towards construction and creation, allied with bodily needs, led to the erection of huts of branches, reeds, and mud. Some degree of ingenuity, some thought and planning, were required even in the

production of a primitive hut. Plate 1, Fig. 3, shows an Indian hut made of reeds and branches, similar no doubt to those raised by prehistoric man, for the savage of to-day seems but little, if at all, advanced beyond his forefathers.

Lake-dwellings. Then the lake-dweller, some three or four thousand years before Christ, built his huts upon piles driven into

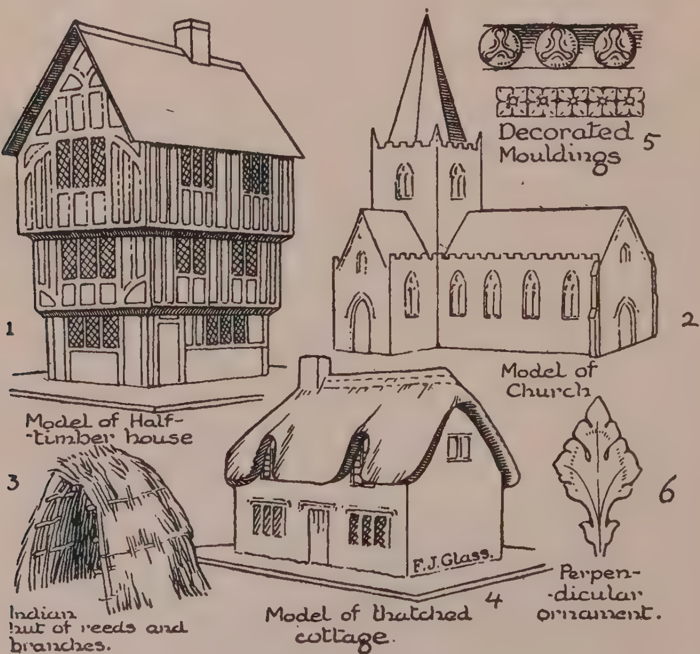


PLATE 1.

the banks of lakes in France and Switzerland. These lacustrine dwellings have long since disappeared, but Plate 2 will give us an idea of what they looked like. It seems incredible that classic temples, Gothic cathedrals and churches, Renaissance palaces, and modern skyscrapers should have been evolved from these huts of branches, reeds, and mud, yet the first chapter contains the hut, while the latest holds bridges, factories, theatres, dwellings, churches, cathedrals, and all the

edifices which are rising day by day. The story that has been written between these two chapters is long, fascinating, and wonderful.

The Home of the Scholar. The child knows his home best of all. He was born into that home, and it has become a part of the fabric of his conception of life, and the world in general. Hence we might well commence with a discussion regarding the home. The house itself, and the materials which were used in its construction, leads to stone, bricks, tiles, wood, lime, etc. Each of these materials will provide food for thought.

Stone. Stone is of various kinds, sandstone, limestone, and igneous rock of many varieties are employed for building. Marble, alabaster, travertine, Portland, peperino, granite, basalt, Bath, Mansfield, Caen, and other distinguishing names are used, according to the composition of the stone or the district from whence it is obtained.

Egypt. Egyptian is the oldest masonry of which we have any accurate knowledge. Limestone, granite, basalt, diorite, sandstone, and alabaster were employed by the people of the Nile, and they achieved a degree of skill in working stone which has hardly been surpassed. Their tools were crude, compared with those in use to-day, yet they produced work which is wonderfully neat and accurate. Granite (a very hard stone) they are supposed to have split from its bed by means of rows of wooden wedges, inserted into the rock, and wetted so that they swelled, forcing the rock asunder. It was sawn into blocks with tubular drills. Professor Petrie tells us that to raise the enormous blocks into their positions on the building, an inclined roadway of earth or brick was constructed to the top of the wall, and the block forced up the inclination by slaves. Labour was cheap in those days. Instead of mortar as we know it, a mixture of lime and burnt gypsum (plaster of Paris) was generally employed, as well as dowels of metal and sycamore.

Fig. 3, Plate 2, is a sketch of the Pyramids, those huge impressive tombs wherein lay for centuries the embalmed

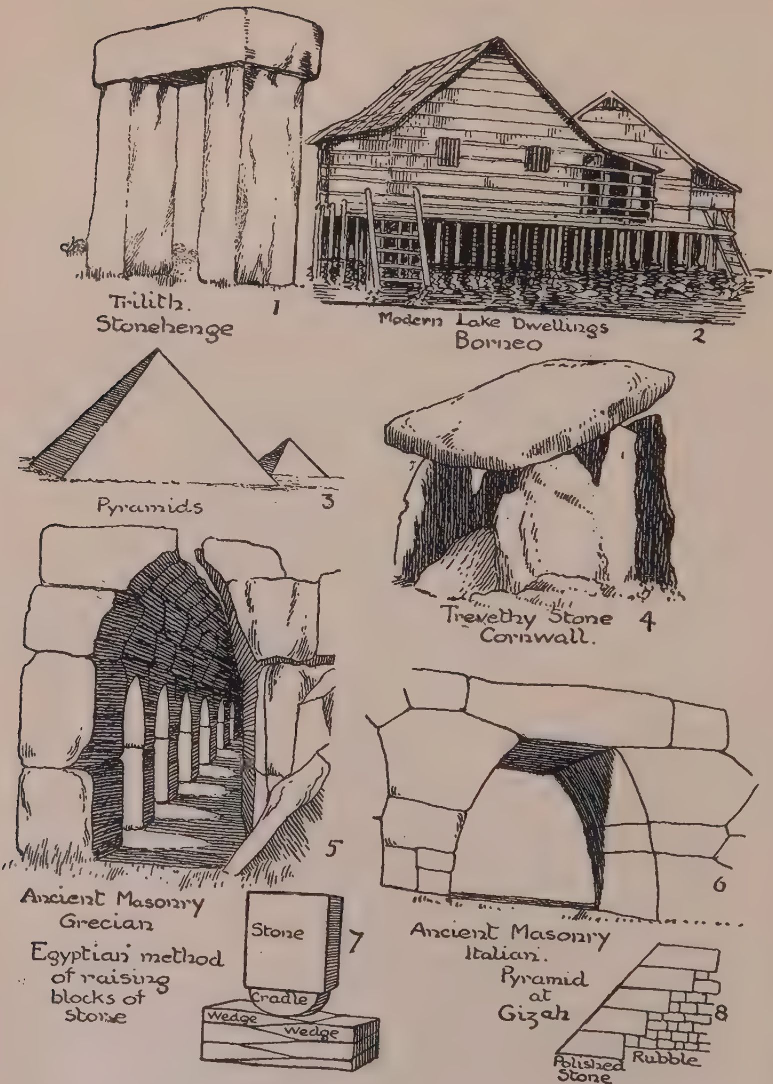


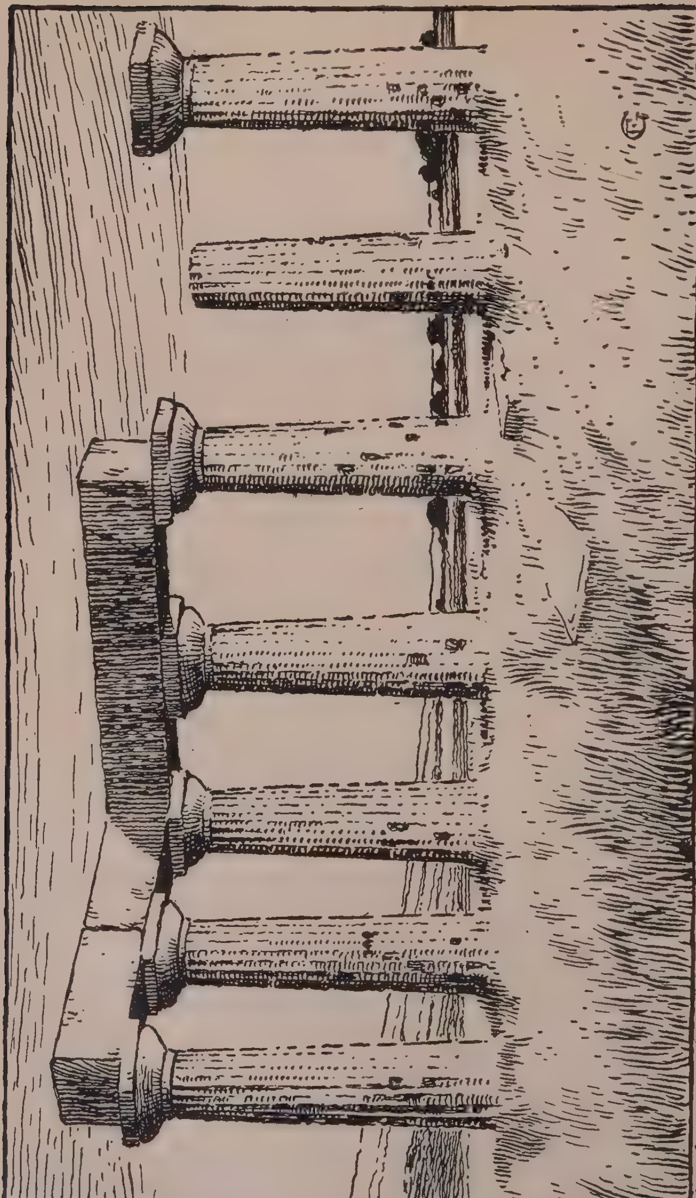
PLATE 2.

bodies of Egyptian kings awaiting the time when their owners should return to claim them. These people knew but little of arch construction, hence their

architecture was mainly trabeated with a slab of stone spanning the space between two columns. Fig. 8, Plate 2, indicates the method used in the construction of the Pyramids. The interior was of rubble, which was faced with polished stones, the joints between being extraordinarily fine and accurate. Fig. 7 illustrates a method used for raising large blocks of stone. A block was placed upon a cradle, which was rocked from side to side, while wedges were inserted below, and driven into place, thus lifting the stone.

Stonehenge. Fig. 1, Plate 2 is a trilith at Stonehenge about which little if anything is definitely known. The huge circle of stones of which this forms a part is supposed to be Druidical, but we have no accurate knowledge, and can only speculate as to the origin and significance of these monuments being due to the activities of some bygone race, whose passage through time is hidden in the mists of antiquity. Fig. 4 is a similar group known as the Trevethy stone in Cornwall.

Greeks. The Greeks used limestone or marble and the accuracy of their jointing is wonderful. Dowels and metal cramps held the blocks of stone together. These people raised the standard of architectural design to a level which has scarcely, if ever, been surpassed. Their sense of proportion and grace of line have furnished models which have been at once the inspiration and the despair of later architects and builders. Marble is comparatively easy to work. It might be termed a fluent medium compared with granite, and it is probable that it played an important part in the evolution of Greek art, by providing the artist with a ready means of expression. Whether the hardness of the native stone helped to decide the peculiar characteristics of Egyptian work, or whether it just happened to suit it, would be difficult to say definitely. Probably it had its influence. Thought is undoubtedly stimulated by expression, and it seems more than likely that the plenitude of marble in the Isles of Greece was to some extent contributory to the high degree of civilization arrived at. An example of



Ruins of Doric Temple, Corinth.

PLATE 3.

Greek masonry, and the ruins of a temple, are illustrated—Plate 2, Fig. 5, and Plate 3.

The Romans used a soft stone called tufu, a compact limestone known as travertine, and a hard volcanic stone—peperino. From the travertine when burnt they made mortar and concrete for jointing, for which purpose they also used dovetailed dowels of lead. The Byzantines used stone and brick in alternate layers. *Roman.*

Saxon masonry is rough, and lacking in skill. *Saxon.*

Norman is heavy and somewhat clumsy, but much superior to the earlier Saxon. *Norman.*

In the Gothic period there is a vast improvement, some of the later work being truly marvellous in its skilful manipulation of stone. Mortar, and metal cramps and dowels were used. Local stone was largely employed owing to difficulties of transport, though a quantity of Caen stone was shipped from Normandy; while Purbeck or Bethersden marble shafts are often found, contrasted with white freestone masonry, far from the places where they were quarried. *Gothic.*

In modern times stone is blasted from the quarries by means of explosives, after which the blocks are sawn and chiselled into convenient shapes and sizes. *Modern.*

Bricks

Again we return to Egypt where we find the natives using the sun-dried mud of the Nile for building purposes even as did their forefathers six thousand years ago. Possibly we have wondered why the Israelites found it so difficult to make bricks without straw, and why they complained so bitterly when forced to do so. The reason was that the friable Nile mud soon crumbled unless held together with straw, or other binding material. The earliest mastaba or royal tombs were made of sun-dried bricks, faced with stone. *Egypt.*

In Assyria, Chaldea, and Mesopotamia, bricks were largely used (again sun-dried and bound together with straw) for work which was not exposed to damp; but *Assyria.*

for the bases of walls and external portions, bricks of fired clay were substituted.

Persia. In Persia brick was the chief building material, both types being employed, burnt and sun-dried. Lime mortar was used for binding the fired bricks together.

Greece. In pre-Hellenic Greece sun-dried bricks were used, but strangely enough nothing of brick survives from the Hellenic period, though Vitruvius mentions its use. We have seen, however, that marble was plentiful, so that bricks were not needed very badly.

Roman. The Romans employed bricks extensively.

The Byzantines built huge edifices like Santa Sophia of brick.

It was used also by the Saracens, and to a greater or lesser extent during the Romanesque, Gothic, and Renaissance, right down to modern times.

America. In Arizona, California, Mexico, and other parts of Western America there are a number of structures of sun-dried or adobe bricks.

Brick-Making

Clay. Bricks we have seen are of clay, sun-dried or fired. The brick which has been burnt in the kiln is naturally much harder and more durable than the sun-dried. Clay is found in many parts of the country and bricks are manufactured in a number of places. When found, the clay is not suitable for brickmaking, it must first be washed, tempered, and pugged before it can be moulded, dried, and fired into the finished brick.

Washing. The washing takes place in a large tank wherein a set of paddles revolve, churning the clay into a liquid state called "slip." The slip is next drawn off, allowing stones and other foreign substances to remain at the bottom of the tank.

Grinding Shale. When, as sometimes happens, the clay is obtained in a hard lumpy form termed "shale," it must be crushed and ground before it can be converted into slip. A large, circular iron pan is used for this purpose, which

is effected by two heavy wide wheels, revolving just within the edge of the pan. A narrow tread on these wheels or rollers supplies the cutting action which effectively crushes the dry shale. Exposure to the elements saves a good deal of time and labour, in reducing the shale to powder. The base of the circular pan is perforated, and the clay, when sufficiently fine, falls through upon a wide moving belt with raised edges which prevent the clay from falling off. This belt carries the powder to a box, wherein revolve a set of large iron knives. These knives mix the clay thoroughly with the water which is constantly spraying into the box. These are the tempering and pugging processes. It is tempered with the water until the right proportions exist, while the pugmill well mixes them and so ensures an even consistency. Sometimes bricks are moulded by hand, but more often by machinery, which is rapidly superseding hand methods. In either case moulds are needed into which the clay is pressed.

Pugging and Tempering.

Moulding.

Hand Moulding.

In hand moulding the workman takes a lump of clay (approximating in size the required brick) and throws it forcibly into the mould which has previously been dipped in sand or water. He then rams the clay well into the mould with a flat board, to which a handle is fixed. The surplus is next removed by drawing a straight-edge, called a "strike," across the top of the mould. The brick is now turned out, this being facilitated by the water or sand into which the mould was dipped, and allowed to dry.

Machine Moulding.

In machine moulding the clay is forced from a large cylindrical tank, by means of a piston, through a rectangular opening, usually 9 inches by $4\frac{1}{2}$ inches (two dimensions of a brick). The continuous bar of clay so produced is passed along the cutting table, and, by means of a frame or wheel in which are spaced a number of wires, a brick's thickness apart, usually 3 inches, it is cut into bricks. Another form of machine presses the clay into moulds, six at a time, and passes them to a table where a man strikes off the superfluous clay and

hands them to another man who turns out the bricks, when the machinery returns the moulds to the press to be again filled. The clay must now be allowed to dry thoroughly, otherwise the moisture would be converted into steam, with disastrous results.

Drying. The bricks are placed on racks, one tier above another, set on edge with a space between, in order that the air may circulate about them.

Firing. The firing takes place in a kiln—a large oven-like structure with an arched roof, above which rises a tall chimney to produce the requisite draught. It is usually of brick, lined with fire-brick. The dried clay is piled in such a manner that the heat may circulate freely. Under the kiln is a fire chamber, generally stoked with soft or bituminous coal, which in burning emits a gas, which is itself consumed within the kiln among the bricks. The requisite heat—somewhere about 1,200 degrees Fahrenheit—is gradually arrived at, and then as gradually lowered, so that usually a week is required for baking the bricks. The fire-bricks which line the kiln are made of clay mixed with powdered brick, previously fired and finely ground.

Fig. 4.

Tiles. Tiles are made in a similar manner to that which is used for ordinary bricks save that, as they must be impervious to water, they are fired at a higher temperature, and are usually made of a good quality of red clay.

Roofing. In addition to tiles, stone, slate, thatch, wood, sheet-iron, lead, and concrete are frequently used, while tarred felt and other materials have been pressed into service.

Slate is quarried in various parts of the kingdom, but especially in Wales, Cumberland, and Scotland. The rock is first blasted, and the masses thus loosened are divided by means of wedges into blocks, and again by finer wedges into thin sheets. The natural cleavage of the rock facilitates the operation. Fig. 4 shows a workman engaged in splitting slates. When covering a roof the slater commences at the eaves in order that the slates may so overlap as to keep the rain from penetrating. *Slate.*

Having touched lightly upon some of the materials used in the construction of the home, and made a few enquiries into history and methods, we might well introduce an exercise. It should be easy to obtain clay, in

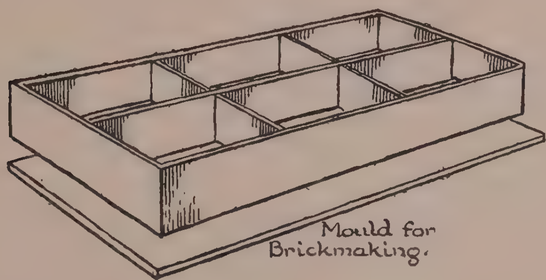


FIG. 5.

many districts local clay is available, if not it can easily be procured. In most schools modelling clay is used. The next stage is to make a mould similar in proportion to the brick in common use, though actually smaller. The average brick is 9 inches by $4\frac{1}{2}$ inches by 3 inches, so that a useful size for our bricks would be 2 inches by 1 inch by two-thirds. A mould similar to that shown in Fig. 5, which takes six bricks, is useful, as it expedites the work. Into this press the clay and ram well home, after dipping the mould into water or fine sand. For removing the brick a rectangular piece of wood similar in size to the interior of the mould will be useful. When the requisite number of bricks have been made they must be set aside to dry. After a day or so they may be fired in an oven, or furnace, or built into *Making Bricks in School.*

arch-like piles in the school yard and a fire built round them. It is necessary to bring them to a red heat, and to keep them so for about an hour.

House-planning. In the meantime we return to the home and consider its planning and arrangement. A discussion is instituted with regard to the location of the house relative to sunlight, air, drainage, and water supply. Its structure, shape, materials, number and purpose of the rooms, heating, lighting, and ventilation.

Doll's House. To make the ideas so engendered more concrete a doll's house is constructed. The type of house undertaken will depend upon conditions and the materials which are available. If possible it is perhaps best to make a wooden one as indicated in Fig. 1, Plate 6. Failing this a number of boxes, of cardboard or preferably wood, can be procured, treated as separate rooms, and assembled into a complete whole. The purpose of each room, together with its planning, decoration, and furnishings, is examined and discussed. The children are led to discover the best situations for the rooms with regard to each other, why they are grouped about the entrance hall, or along a passage or corridor. Why each room should be well lighted and aired, particularly the sleeping apartments. Why the bathroom is tiled and usually light in tone. The positions of door, windows, fireplaces, and other necessary fixtures, etc. There is plenty of material here for lessons and discussion. Pictures, diagrams, plans, and elevations of houses should be procured and examined, so that the children may become familiar with them. The pictures will assist in giving a clear tangible idea of things, while the ability to understand diagrams, plans, and elevations is bound to be of service later on.

Comparison of Types of Homes. Another avenue for thought is a comparison between the various types of dwellings, and of other buildings, which have been erected by different peoples at different periods.

Indian. The wigwam of the Indian, Fig. 2, Plate 6, which though perhaps lacking in comfort from our standpoint,

is yet well suited for a people whose stay in any place was dependent upon the movements of the buffalo, elk, or other animals. Sometimes the Indians give other names to their homes according to the tribe or the type of place it is. Lodge, tepee, hogan, ramada, and kan

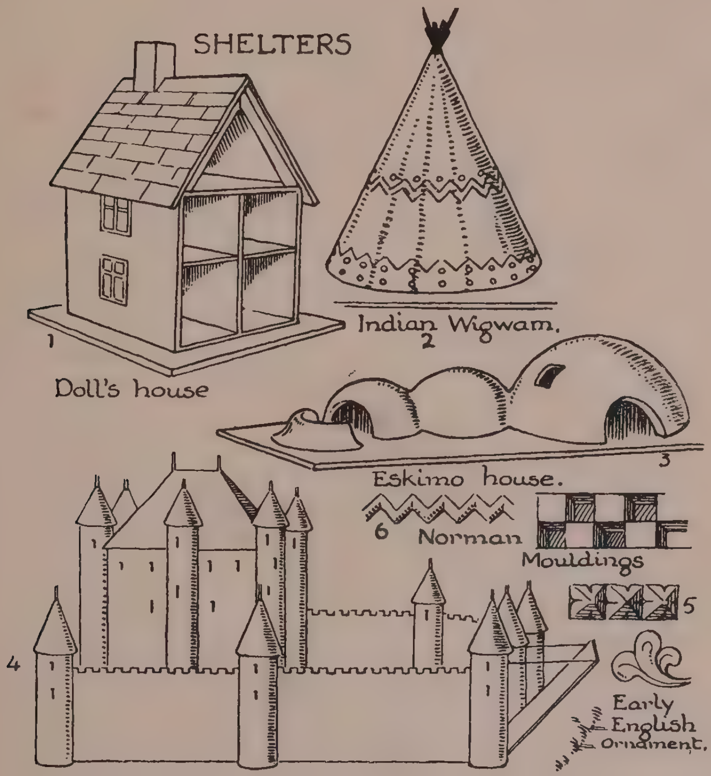


Plate 6.

are used in addition to wigwam. The Indians who dwell in the plains call theirs tepees, and this in earlier days was of buffalo skin painted with battle or hunting scenes in bright colours. Now they are mainly of cloth because buffaloes are more rare, and the hunting of the Indians restricted, as they are compelled to live in

reservations. The framework of the tepee is of poles from 12 to 16 feet long, tied together at the top. The door is simply a flap, while an opening at the top serves as a chimney. The fire is built in the centre of the tent, upon the ground, and a kettle slung over the fire serves for cooking purposes. Upon skins and blankets the family sleeps. The hogan is the house of the Navajo Indian. It is a framework of poles, with a layer of bark and grass, above which earth is placed. Again, the chimney is simply a hole in the roof. Still another type of house is built by the Wichita Indians. A number of poles are driven into the ground and fastened together at the top. About these horizontally, like the hoops of a barrel, are bound other sticks, and into them is woven grass so that the house resembles a bee-hive. These dwellings should be compared with an Arab or Hebrew tent, both of which, like the tepee, and the wigwam, are peculiar to nomads who desire to move easily from place to place. They shall "fold their tents like the Arabs and as silently steal away." A model of a wigwam can easily be made with some sticks and cloth.

Gypsies. The only people dwelling in Britain to whom we can liken these nomads are the gypsies who live in caravans, which they often supplement with huts and tents when encamped. They may be seen in many parts of the country, especially where there are large stretches of common, and where race-meetings are held. Some of their caravans are very sumptuous, but generally the mode of living amongst the gypsies is somewhat primitive. George Borrow in *Lavengro* and *Romany Rye* gives excellent accounts of their habits and manners. The genuine gypsies are proud of their race and ancestry, and very scornful of the hawker and the impostor who has deserted the manner of life to which he was born, to adopt theirs. A gypsy encampment in the New Forest (where there are many) or on a common, gorse and heather clad, certainly looks very romantic and picturesque (Plate 7), but seen on a racecourse amidst

booths and other temporary erections the caravans appear tawdry, and the people squalid, especially when engaged in fortune-telling or hawking tips. Caravans belong to lanes, byways, and moorland tracks; on the highways with motors passing and repassing they appear incongruous, while in a town they seem altogether out of place. In some forest glade, or on a moorland track, they suggest travel, adventure, and the glamour of

PLATE 7.

mobility. The whole countryside with its peace, and its everchanging loveliness of cloud and sunshine, its trees, flowers, hedgerows, and open spaces, awaits the dweller in the caravan, who has simply to harness his horse when he desires "scenes afresh and pastures new." The caravan provides shelter from inclement weather, while on fine days it is pleasant to live in the open. Those who dwell in a hovel in some narrow street, one of the many which make up a sordid district,

can hardly fail to be depressed by the monotony of their surroundings. Whatever may be the disadvantages of life in a caravan this is certainly not one of them.

Boy scouts and girl guides will know something about tents, and will appreciate those now under consideration.

Eskimo. The Eskimo builds a hut of snow in the winter, because, strange as it may seem, it is much warmer and less draughty than a tent of skins—Fig. 3, Plate 6. Having chosen a place where the snow is closely packed and deep, he proceeds to cut it into blocks of about 2 feet by 30 inches by 10 inches. This he does with a large knife. These blocks are placed upon the snow surrounding the hole from whence he has cut them in the form of a circle. Upon this circle he arranges another one, sloping inwards somewhat, and so on, until the top becomes small enough to be closed with a single block of snow. There are of course large crevices between the blocks so laid, which are carefully filled with snow, as the wind is bitterly cold in those Arctic regions, and must not be allowed to enter the dwelling. Having built the walls, he must needs think about doors, or rather entrances and windows. The latter are just sheets of clear ice let into the snow wall. The doors are openings cut beneath the wall, and leading to a tunnel bored through the snow for some distance. There is a door at both ends of the tunnel (if we may term blocks of snow or skins doors), and both are needed to keep out the cold. It is wonderful how man can adapt himself to circumstances. Snow to us seems scarcely the stuff to build houses with, but when it comes to making beds and furniture of it, we are inclined to shudder. Yet the Eskimo does. He packs his snow hard, and if he can obtain them he places twigs, moss, and grass above, and over these he lays the skins which serve as bedding.

Furniture.

Heating. The heat for the hut is provided by a lamp of stone, or shell, in which burns a wick of moss, floating in oil which has been obtained from the blubber of the whale.

In the restricted area of this hut, through the cold, and the silence, and the semi-darkness of the long Arctic winter the Eskimo and his family live. Sometimes he ventures forth to cut a hole in the ice so that he may catch fish, or to hunt animals for food, but mainly he lives in his hut of snow. Strangely enough it is only the cold which keeps the house together, and as soon as spring appears it begins to melt, making another form of shelter necessary.

Tents. This is made of skins, usually walrus or seal sewed together. The poles are of wood, when it is obtainable, otherwise they are the long bones of whale or walrus. This tent, Fig. 8, Plate 8, might be compared with the others we have mentioned, because the purpose it serves is similar, for the Eskimo moves from place to place in search of animals.

Japan. The Japanese dwelling differs very considerably from the English. The smaller ones are usually made of bamboo and paper, with roofs of tiles or thatch. Of course there are larger and more substantial ones, which contain all modern conveniences, together with expensive furniture and art work. The poorer dwelling, however, is rarely more than one story in height, and the roof is either thatched, tiled, or shingled. The tiler embeds his tile in mud which is spread upon boards fastened to the roof. The wooden shingle is fixed in place with pegs of bamboo. The doors do not swing upon hinges as do ours, they are sliding panels, with a frame of wood upon which paper is stretched. The walls or partitions are also of wood and paper. Sometimes the paper is plain, and sometimes it is ornamented, and when we remember the extraordinary skill with which the Japanese artist wields his brush we can guess what gems of art these decorations must often be. The windows too are frequently of paper, though glass is by no means uncommon. Chairs are somewhat rare as the Japanese sit upon soft straw mats which cover the floor. Consequently the shoes are removed before entering the room, lest they should soil the mats.

Pictures. One very charming custom prevails in the Japanese home which might well be copied in the British. They have very few pictures on the walls at one time, but they change them frequently. Instead of a closely packed mass of frames, each containing a picture which clamours for attention, and in all probability quarrels with those about it, they have but one or two upon a wall space. Seen under such conditions it is possible to appreciate the beauties of a picture.

Flowers. The Japanese are also very fond of flowers, and in every room there are vases containing them. Here again they know how to display the beauty of the decorations by their skill and taste in arranging them.

China. In China we may see the ancient jostling the modern, or perhaps it would be better to say that Eastern methods and customs exist side by side with much that belongs to the Western hemisphere. Many of the poorer Chinese build houses of mud or clay supported by a framework of bamboo, roofed with tiles or thatch. The partitions are woven with strips of bamboo plastered with mud. The chairs, tables, beds, etc., are also of bamboo, while the floor is hardened mud, with no mats or carpets.

The windows are sometimes a lattice of bamboo, with pieces of thin shell fastened into the interstices, and sometimes of paper, with heavy wooden shutters. The heating is provided by a stove of brick and plaster, or by a sort of box containing sand in which a fire burns.

The better-class houses are of wood, stone, or brick, usually with a tiled roof. These are well furnished. Many of the Chinese live on rafts or boats moored to the bank of a river.

Canada. The Canadian log cabin, Fig. 3, Plate 8, is worthy of attention because it provides an example of man's adaptability to circumstances. Brick or stone would be difficult, if not impossible to obtain in the backwoods, while trees are plentiful. Consequently the early settlers, when they desired to build a shelter, felled a number of trees, sawed them into suitable lengths, and

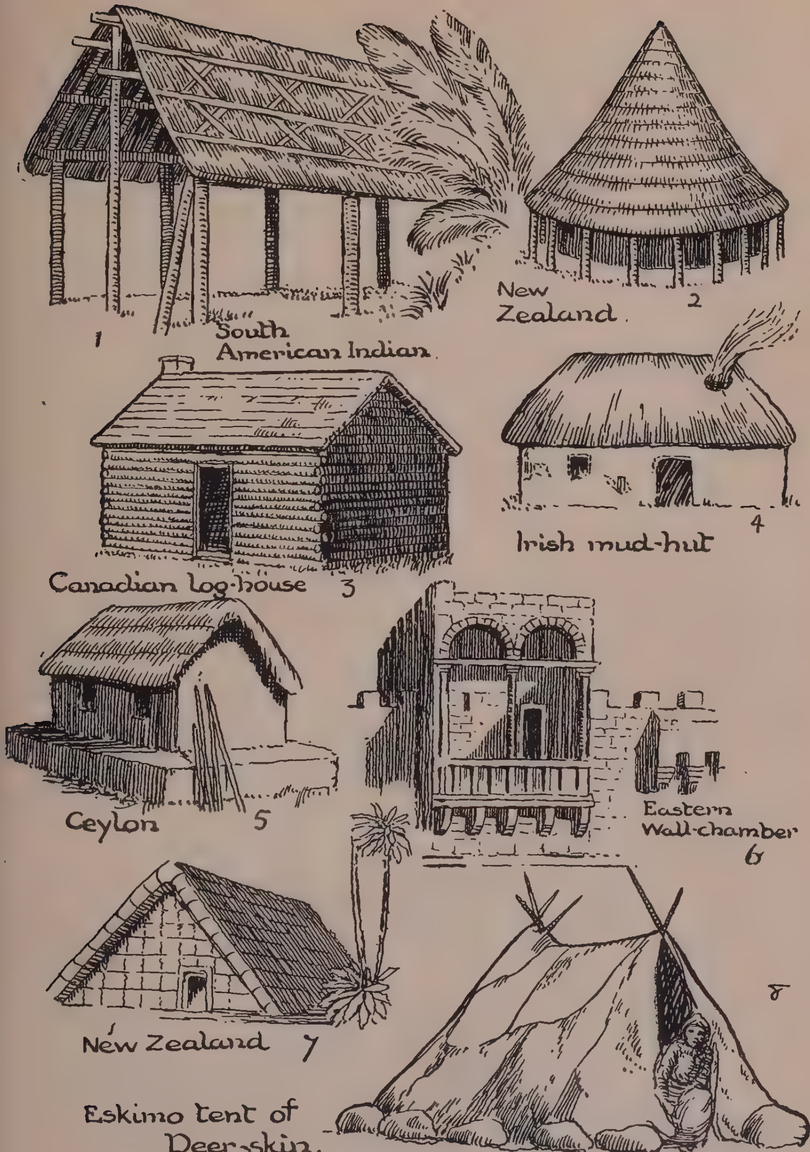

1
South
American Indian
New
Zealand
2
Canadian log-house
3
Irish mud-hut
4
Ceylon
5
Eastern
Wall-chamber
6
New Zealand
7
8
Eskimo tent of
Deer-skin.

PLATE 8.

cut notches at either end. Two logs were placed on the ground, as far apart as the desired width of the house, with the notches uppermost. Across the ends of these were laid two other logs, with the notches down so that they fitted into those in the other logs. These commenced the ends of the house. Upon this first set of logs others were laid, and the process continued until the walls reached the necessary height. The gables were made by raising the end walls with gradually diminishing logs until the angle was reached. The ends of the logs were cut on the slant, and fastened together with wooden pins driven through holes bored to receive them. Above these were laid the rafters, again pinned with wood. The roof was made of boards into which short sections of logs were split.

Furniture. The furniture was entirely home-made, and the mattresses for the beds filled with dried grass, or corn husks. The fireplace and chimney was of stone. Such were the homes in which the early settlers in Canada lived. No carpets, or pictures, no light save that furnished by the log fire and the tallow candles. Water was obtained from a spring, in close proximity to which the builder would naturally select his building site. Nowadays, since railways and easy methods of transport have opened up the country, the conditions are much easier, and the life of the settler rather more comfortable, but in bygone days he must have had a hard struggle. Log cabins such as these have often been besieged by Red Indians, and sometimes the scalps of the inmates have gone to decorate the wigwams of bloodthirsty Redskins.

There are many stories of the battles that took place between the white man who desired to hunt, or farm, or lumber, and the Indians who resented his arrival in the land which had been theirs so long. It is remarkable that in so short a time the white man should have established his mastery, and the red man have sunk almost to insignificance. Longfellow in " Hiawatha " gives us a beautiful, poetic account of Indian tradition and folk-

Red Man and White.

lore, interwoven with many musical native words. From this we gather that they were not wholly brutal and bloodthirsty, but like most other races, they had their dreams and aspirations. But they were quite unfitted to cope with other nations. They had no contribution to offer to the evolution of thought and progress. Their sun had set, and the day when they might perhaps have fitted themselves to take a part in the affairs of the world had drawn to a close, leaving them unprepared. In the struggle for existence they went under, not because they were physically weak, or cowardly in character, but because they were too self-centred. Strange as it may seem, they were too warlike, too aggressive, for "the race is not always to the swift, nor the battle to the strong." Their attitude to life was a suicidal one. They hunted recklessly, but did not think to till the soil, or prepare for the future. If they had enough for to-day, let to-morrow take care of itself. It is not selfishness, but altruism which wins in the long run. Construction is vastly superior to destruction, and the people who build for the future will help to mould and dominate that future, while those who think only of the present, will, in all probability, end with the present. Despite the glamour of romance with which many of our writers and historians have seen fit to surround them, the debt we owe to warriors and conquerors is small compared with that which we owe to the thinkers and the makers. A man who has added a fact or a thought to the knowledge, or made an article for the use or enjoyment of mankind, is more worthy of our gratitude than any who have wielded the sword. It is as true of nations as of individuals that "He who uses the sword shall perish with the sword."

South America.

South American huts such as the one in Fig. 1, Plate 8, are merely roofs made of broad leaves supported upon three rows of poles, the centre row being higher than the outer ones so that the roof may slope downwards from the centre ridge. There are no walls to these huts, the only protection against the weather is

provided by mats hung at the sides. The Indians sleep in hammocks suspended from the roof.

New Zealand. The natives of New Zealand make quite superior huts of branches and twigs covered with rushes—Fig. 7, Plate 8.

In Ceylon mud is used covered with grass or some such material to protect it from the weather—Fig. 5, Plate 8.

Ireland. In Ireland there are still mud cabins as shown in Fig. 4, and very crude and primitive they are. One can scarcely believe that in such hovels human beings contrive to exist. Seen on a wet day (and there are many in the Emerald Isle), with the pigs and the hens wandering in and out, carrying mud and filth into the interior, a more comfortless place can hardly be imagined. In the wilds of Donegal, on the bleak stony hillsides, where it seems difficult for anything to grow, these cabins and their occupants serve rather to accentuate the loneliness and the melancholy of the scene, instead of relieving them. The Irish peasant has many characteristic qualities, which are peculiar to himself. He is religious even to superstition, and believes in many things which are regarded as moonshine on the other side of the Irish Sea. A schoolmaster whom I met in county Donegal began to tell me about the fairies or "Little people" as he termed them. To him there was nothing unusual about the idea. He spoke quite without restraint or shyness. He had seen them at work, he told us, had watched them, but unfortunately there was an Ulsterman present, whose scoffing scepticism stopped the account abruptly. So to my regret I heard no more about the fairies, despite my attempts to turn the conversation back to them.

J. M. Synge in *The Playboy of the Western World*, *The Tinker's Wedding*, *Riders to the Sea*, and other plays, gives excellent pictures of the Irish peasant with his eerie thoughts and strange notions. James Stephens too, deals with them, though more humorously, for his writings are typically Irish in their extravaganza.

Patrick Macgill has written some sad stories of peasant life in *The Rat-pit* and *Children of the Dead End*. George Birmingham is perhaps better known than James Stephens, but it would seem that his characters and

PLATE 9.

incidents are drawn for the benefit of readers of other nationalities, rather than for the Irish themselves. The Irish are a poetic and an artistic people, as might be expected from Celts. In bygone days they were excellent craftsmen, as the *Ardagh Chalice*, the *Tara Brooch*,

the *St. Patrick Bell Shrine*, *The Book of Kells*, and other works of typically Celtic design bear witness.

There are other countries and other peoples whose dwellings will furnish interesting comparisons, but

PLATE 10.

enough has been written to indicate the lines along which we might proceed in our consideration of this aspect of dwellings. Fig. 6, Plate 8, shows an Eastern chamber built on the wall, while Plates 9 and 10 are examples of Oriental architecture.

History of Shelters

Another aspect of buildings is that of the evidence they bear of the evolution of human thought and progress. If we can read aright we shall find upon each monument, each erection which man has raised, the thoughts and aspirations which called it into being. History is engraved upon the habitations, tombs, temples, places of worship, and the civic or other buildings, wherein man has dwelt, worshipped, worked, transacted business, or slept his last sleep. A little thoughtful consideration will reveal the history, and much may be learned of these and other days from buildings.

We have touched lightly upon Stonehenge and similar monuments, upon the Pyramids, and the temples of Egypt and of Greece. These buildings stand like milestones along the pathway trodden by the human race. Were it not for these milestones (if I may so call them) the path would be even more difficult to trace than it is at present. Upon the tombs and temples of Egypt is graven in hieroglyphics and *cavo-relievos* the history and beliefs of the people of the Nile. Before the Rosetta stone furnished the key, the significance of the figures, reliefs, and hieroglyphs, wherein was written so much about a bygone civilization, was unknown. Now we may learn how they lived, and worked, and died, and how, and what, and whom they worshipped, these dwellers in the Nile valley. We may see how in Osiris, the resurrection god, was typified the annual rebirth of life along its banks, due to the overflow of the waters of the Nile. We know how fervently they believed in their own rebirth, and how they embalmed and entombed the bodies of their dead, so that they might await the return of the spirit who owned them. The dry sand, and the plenitude of sunshine, acted as preservatives ; nature seems to have decreed that all things should last in Egypt. Their stone was mainly granite, and so, if we can sum up the ideas and beliefs of a people in one word, that word for the Egyptians would be duration.

Milestones.

Osiris.

Hence they built, and carved, and wrought on a colossal scale. They prepared for the future because the present was of so little import.

Assyria. The Assyrians had other ideas, they were more full of the joy of life. They hunted and fought, and in their bas-reliefs we see muscular figures engaged in such occupations, and also, sad to say, in scenes of revolting cruelty. If there was a future it could care for itself; life as they knew it was quite absorbing enough for these people.

Greece. In Greece somewhat similar ideas prevailed, though with an added grace and refinement. The Greeks too were enamoured of life, but beauty was added to their conception. They loved the well-proportioned athletic body, the trees, flowers, rivers, and streams. Hence their gods were glorified human beings, each the apotheosis of some human attribute, while their woods and open spaces, rivers and streams, they peopled with nymphs and dryads, fauns and satyrs. The sea, the sun, the thunderstorm, night and day, the earth and the nether regions were typified in some god or goddess. Their whole conception of life and the universe was anthropomorphic, because they were so interested in man and his affairs. The evidence of this is seen in their sculpture, in the harmonious proportions of their temples, and the beauty of their decoration.

Roman. Roman work betrays the thought which called it into being. It also betrays its Greek origin, though it lacks the æsthetic quality and the refinement of its prototype. It is heavier, more ostentatious and grandiose, coarser in fact, as might be expected from a nation who gloried in conquest. The whole Greek Pantheon was adopted by the Romans, the only difference they made was to alter the names of the deities. Zeus became Jupiter, Hera—Juno, Aphrodite—Venus, Hermes—Mercury, Eros—Cupid, and so on. They also managed to debase the conception of these deities. Dionysus, for instance was in Greece, the embodiment of that ecstasy which dwells in the wine cup, that intensity of emotion which

lifts man above the commonplace, and the humdrum of ordinary existence, into the realm of the gods themselves, and which exists in the sparkling juice of the grape. This was Dionysus, but Bacchus was quite another person when the Romans had finished with him. He represents the licence, the debauchery, and the drunken orgies indulged in by men of coarser fibre. Something of this subtle difference, this blurring of the original fineness of conception, the Romans managed to infuse into the whole Pantheon. Triumphal arches, columns to commemorate conquests, huge colosseums, and amphitheatres, all more or less inspired by some warlike or pompous motive. These were the buildings chiefly raised by the Romans. They also built aqueducts and other useful structures.

Up till now the religion of Europe had been pagan. Spiritual ideas were weak and undeveloped. The intellect was the dominant factor. The tangible took precedence over the abstract. Then from the East, by way of Byzantium or Constantinople, came Christianity, and spiritual and emotional ideas challenge the intellect for ultimate supremacy. Into architecture colour enters as an integral part, rather than as an adjunct to form, which was previously the position it occupied. There was of course no definite line of division, no date to which we can point saying, "Here entered the spiritual and departed the intellectual." It was a gradual change, the premonitions of which were evident in the days of Socrates, who himself expounded the wider, broader life which was even then opening out, but the time was hardly ripe yet, so he paid the penalty. A cup of hemlock was his reward. Such is the payment meted out to those who dare to think and feel, ahead of their fellows. We object to new ideas, because they make us feel uncomfortable. We have to think, which in the main we object to, because it needs effort, and often upsets our preconceived ideas of things. "Beware when the great God lets loose a thinker on the planet, for all things are at stake."

Christianity.

In addition to the use of colour as an emotional agent, the treatment of the human figure underwent a change. The Church feared that if treated too naturalistically, if it was made too beautiful, it would tend to keep the attention fixed upon itself, instead of leading the thoughts of the observer upward to more spiritual moods. Consequently we find the human figure rendered in an attenuated, emaciated form because it was considered to be more spiritual, more suggestive of the soul than a well-developed or beautiful figure. The world, the flesh, and the devil were grouped together as factors inimical to spirituality.

The buildings were massive and ponderous, and the interiors of the basilicas dim but colourful, as though they sought to achieve a "dim religious light." The emotion evoked by colour was regarded as being more conducive to religious feelings than the intellectual interest aroused by beauty of form or harmony of proportion. That was at the beginning, when mundane things were regarded as wholly antagonistic to heavenly. There have been revivals of this belief in later days when Iconoclasts and Puritans have relieved their feelings by smashing the works which were looked upon as too beautiful to be good. Truth was not beauty, nor beauty truth, to these fervent extremists. But ideas changed, and the Church, partly no doubt from selfish motives, allowed the artist and the craftsman a wider scope. In the first place it was necessary to do this, because very few people could read, and the artist or sculptor by depicting incidents, and by symbolizing abstract ideas, was able to convey some part of the message which the Church would fain deliver. In due course as the conception of God became wider and deeper, and people began to believe that He was not only omnipotent, and omniscient, but omnipresent, and consequently in everything, it naturally followed that the world was a manifestation of Deity. The earth with its beauty of trees, flowers, and vegetation was the garment of God, hence beauty was worthy of esteem if only for this reason.

Colour.

Iconoclasts.

Something of this attitude towards beauty may be seen in the work of the Gothic period with its wonderful carvings and clustering columns, its upward-pointing pinnacles, and the human and natural forms with which the craftsmen adorned their structures. Gone is the calm serenity of the vertical and the horizontal, as exemplified in trabeated architecture, gone too is the smooth even curvature of the semicircular arch. In their places we have instead a style full of animation and vitality. The arch principle is used with a daring never before attempted, there are lofty vaults with flame-like tracery, and a tremendous vitality of thrust and counter-thrust, static enough in reality, though in appearance strikingly dynamic. How came so virile, so animated a style to grow out of the stilted Roman arch? The term Gothic was first applied (some say by Raphael) in an insulting, depreciatory manner, meaning the work of Goths or savages. The Romans were overthrown by hordes of barbarians, Goths, Visigoths, Ostrogoths and Huns, who for the first four or five centuries were never at rest. Many forms of government came and went, many experiments were tried and thrown aside until what we may term the Gothic ideal was evolved, for the thought, or ideal, must first exist before it can find expression. Though difficult to define in terms of precision, we might say that this ideal consisted in freedom of thought, and action, and behind it all of course the religious ideas we have mentioned. There had come into being a finer blend of spiritual and intellectual. It was no longer held that the spirit was of such paramount import, that mundane things were of no consequence at all. *Gothic.*

There is no room here to enter into the conditions which led up to the Renaissance or Classic revival. Symonds speaks of the Renaissance as "The emancipation of reason," saying that, "The mental condition of the Middle Ages was one of ignorant prostration before the idols of the Church," but after our brief survey of the Gothic we must venture to disagree with him. *Renaissance.*

Towards the end of the thirteenth century, paper was first made in Europe, and 150 years later the first book was printed. When the Turks captured Constantinople and Santa Sophia became a Moslem mosque, Greek scholars took refuge in Italy, carrying with them the manuscripts of Greek classics, while Rome possessed many monuments which for years had lain neglected. These are some of the factors which assisted in the Renaissance. Also it would seem that the pendulum was swinging away from mysticism back towards intellectualism, and in Greece the intellect had been idealized and developed more than anywhere else. During this period we see Pagan myths vieing with Biblical incidents as subject matter for the artist. Titian paints a masterpiece, "Bacchus and Ariadne," on the other hand he also painted "The Assumption of the Virgin," "The Entombment," etc. Tintoretto painted the "Origin of the Milky Way," and the "Presentation of the Virgin in the Temple." Raphael painted the "School of Athens," and on the other side many beautiful "Madonnas." Then we have Dante's *Divine Comedy*, contrasted with Boccaccio's *Decameron* and Machiavelli's *Prince*.

Michael Angelo.

At St. Peter's, the Vatican, and elsewhere we can see the genius of Michael Angelo, that titanic figure of the Renaissance. In him perhaps was the spirit of the age personified. Those fervid figures struggling with terrific energy, seem to suggest that striving towards an elusive ideal, which like the cup of Tantalus was always just beyond the grasp, an ideal which kept Michael restless, eager, earnest, and never content, but for ever pouring out his fiery thoughts in marble, bronze, or paint. During the Renaissance an intense interest in humanity is evinced, an eager desire to reconcile human interests with spiritual interests. Michael Angelo was supremely intellectual and also a mystic, his one interest was the soul of man, and the body as exulted or tortured by the soul. In the Renaissance we note the blend of arch and dome, with the Classic column and lintel.

The column and lintel belong to the intellectual Greeks, and the arch to the more mystic Byzantine and Gothic.

Modern Work. Since the Renaissance it would be difficult to pick out any clear-cut definite style. Thought grows complex and many-sided. If there is a tendency at all it would seem to be dictated by iron and concrete, as befits a mechanical age. We build in every style, and copy every period without discrimination. Our religious edifices we build mainly in the Gothic style, our civic buildings in the Classic, while our domestic architecture is too often nondescript and banal.

Industrial Erections. If there is aught which differentiates this era from its predecessors, it is our industrial and commercial erections. Bridges, factories, blast furnaces, cranes, viaducts, and similar examples of engineering skill seem to be the contribution of this age to the architecture of the world. Often these are really beautiful, because they are built primarily to serve a definite purpose, and because they serve their purpose well, and are not overloaded with vulgar, unnecessary ornament, they become things of beauty and absolute fitness. Industry is not necessarily ugly; and if we strive to build honestly, with due consideration of fitness for purpose, and use our materials rightly, we need not be ashamed of our contribution. It is an age of commerce and mechanical industry. Let us accept this frankly and do our utmost to be true to ourselves, and to the work we are doing, and the æsthetic element will be incorporated whether we aim at it consciously or not.

This brief survey is intended merely to indicate the lines along which this fascinating branch of study may be pursued. It would take far more space than is here available to deal at all adequately with the subject.

Colour in the Home

Colour in the Home. Colour plays an important part in the planning and decoration of the home. A room may be cheerful and comfortable, restless and irritating, or decidedly depress-

ing by reason of the shades selected for its decoration. A discussion regarding colour is calculated to elicit many fruitful ideas. The framework of an ordinary room is the skirting, dado, cornice, frieze, and ceiling, and this framework must be taken into consideration when planning our colour scheme. Unbroken stretches of one shade are calculated to produce an impression of monotony, while large areas of strong hue are apt to be overpowering. The larger the space to be covered the more delicate should be the hue, with a few small emphatic notes to give value to the quieter expanse. The treatment of the woodwork requires care and thought, as the colour will depend to some extent upon the area of the wood. If the area is large, it is unwise to use a dark colour, but if it is small it might well be emphasized by colour which is fairly strong. Where a dado occurs it should be carefully treated in order to avoid too strong a contrast, as restlessness and discomfort are liable to ensue.

The colour of a room should be suggestive of brightness and cheerfulness to those who may enter. Not everyone is fortunate enough to be able to live in a house commanding a pleasant view, or which stands four square to the open sky. Many of us are compelled to live in a dwelling which forms part of a row and is consequently lighted by windows at back and front only.

Colour Schemes. In choosing a colour scheme the quantity and quality of the daylight which normally enters the room is a primary consideration, while the artificial lighting must not be entirely ignored. A room which faces north, where the light is cold, clear and steady, will stand stronger and warmer colour than another which sunlight enters, though here we must remember that for some part of the time the room will be artificially lighted and the artificial light is comparatively warm. Buffs, soft yellows, and apple greens, all fairly warm and bright, are suitable for north rooms, while notes of red or orange may be introduced happily into such fabrics as curtains, cushions, carpets, etc. Schemes of grey and

tender blue or grey and gold, soft browns, walnut and gold, deep blues relieved with dove or silver grey are suitable for south rooms. Walls of ivory or cream form excellent backgrounds for fresh tones in the fabrics for rooms with sunny south windows.

A room facing east is not quite so cold as a northern one, but similar colours may be employed, with the addition of warm greys.

West rooms are warmly lighted, hence subdued colours are best. Almost any colour can be used if thoughtfully applied with due regard for the amount of light which enters. From these brief hints we may gather that cold, hard, or dull lighting calls for fairly vigorous colouring, while strong warm light needs a scheme of more tender hue.

Artificial Lighting. Artificial lighting must be considered in arranging our scheme. For vivid schemes of colour a strong light is unsuitable, and of course a quiet scheme is calculated to stand such light. Much might be said upon this subject of colour, but it is hardly possible to lay down definite rules. Colour is so much a matter of individual taste and judgment. The class should be led to discuss the subject, and in the process the teacher might help considerably in forming the children's ideas. Many builders, and we regret to say many architects too, display the most execrable taste in their treatment of dadoes, ceilings, mantelpieces, etc., by their over-ornamentation of these features. A good deal can be done to correct this by a careful choice of colour.

We have not yet discovered the immense influence which colour wields over the minds and characters, or the bodies either, for that matter, of those who come under its spell.

There are many aphorisms or sayings regarding colour which are not to be dismissed too lightly, as most aphorisms have been founded upon the accumulated knowledge and experience of the people in whose language they are expressed. A few of our own run: "Like a red rag to a bull," "A brown study," "Taking

a jaundiced view of life," "Rose-coloured spectacles," "In the pink," "Purple patches," "A fit of the blues," "Green and inexperienced," and so on. If we consider these sayings we shall discover at least a substratum of reason in them. Red is decidedly an exciting colour, and often upsets people of weak nerve or intellect. Brown is a sombre colour, suggestive of reverie, and perhaps of melancholy too. A jaundiced view suggests that a bilious yellow tinge predominates. Most blues are cheerful, but some of the deeper heavier blues are a trifle sad. Rose colour hints at romance, pink at health and vigour, while purple is full-blooded even to exuberance. These enquiries might profitably be pursued further, but space forbids.

Wall-papers. Patterned wall-papers should be chosen with great care, and with due regard for the room. A small room should never be covered with a heavily patterned paper, as it dwarfs the appearance. A plain paper or even distemper is infinitely preferable. Strong patterns have a distinct tendency to quarrel with any pictures that may be placed upon them. A low room looks more lofty if a paper with vertical stripes is chosen, while a too lofty room may be dwarfed by one in which the horizontal is marked.

Furniture

Furniture. The furniture should make another contribution to the scheme instead of being disregarded when the colour scheme is being considered. The woods most commonly used are oak, walnut, and mahogany, with satinwood to a lesser degree, while ash, beech, birch, elm, deal, etc., are frequently employed.

Oak is very extensively utilized nowadays, and its colour ranges from the light hue of new wood to a brown so dark as to be almost black. Oak needs nothing more than a little linseed oil rubbed in, with possibly a little wax as a polish, for the golden glow of the natural wood, together with its beautiful grain, is well worth preserving. It is unfortunately the custom

to stain it and colour it in the endeavour to make it look antique, with the result that colour and grain are frequently lost in a dirty drab tone. With oak, creamy white, buff or biscuit, some fairly light shades of green or pale primrose for a background, with splashes of brighter colours in the fabrics, will harmonize well.

Walnut is a little softer and darker than oak, but similar backgrounds are suitable with the addition of deeper blues and greens, tending towards warm tones, rather than cold. Splashes of silver, old gold, crimson and deep blues are effective with oak or walnut if used sparingly.

Mahogany is a warm ruddy brown which harmonizes pleasantly with most colours except brown. Satinwood is rarer, but is of a beautifully translucent golden colour, often itself decorated with painted ornament. Its background may be of almost any of the colours mentioned except, maybe, a too insistent yellow.

All these things are parts of the furnishing of a home, and therefore worth discussing with the class. The spacing of the pictures on the walls, the disposition of ornaments and decorative accessories, the inadvisability of overcrowding the rooms with furniture, are all worthy of consideration, and the pupils should be encouraged to suggest, and to compare ideas and suggestions. It will be found that their ideas are indicative to a large extent of the homes in which they live. It is a good plan to allow them to plan colour schemes with simple washes of colour.

Exercises. A drawing of the side of a room divided into the proportions of an ordinary room, with skirting, wall filling, frieze, and cornice drawn to scale, should first be made, and flat washes of colour laid upon this according to the taste of the pupil. These schemes may then be discussed, compared, and criticized along the lines suggested. The aspect of the room, its lighting, natural and artificial, and the furniture and fabrics for which the schemes are suitable should all be considered when the discussion is in progress.

The home environment of the child is unquestionably a potent factor in the formation of character and temperament, and surely this is sufficient reason for bringing it into a scheme of education. A knowledge of what is good or bad, tasteful or vulgar, healthful or depressing, is bound to have a beneficial effect upon the growing generation. It will certainly tend to produce a more thoughtful attitude towards the choice of a home and its furnishing. There are far too many houses which, besides being badly built, are furnished and decorated in a manner which suggests that no thought, and certainly no taste whatever, can ever have been expended upon them. Such places can only exercise a vulgarizing influence upon the plastic mind of the child doomed to live amongst such crude, unwholesome surroundings. This can, to some extent at any rate, be minimized and corrected by wise guidance on the part of the teacher possessing knowledge and good taste in such matters. The lessons in Industrial Arts and Crafts should have this aim in view, amongst the others already mentioned.

Treatment of Schoolrooms.

The schoolroom itself provides possibilities in this direction. It is hardly feasible for the class to undertake the decoration of the room, as far as paint, paper, or distemper are concerned (though this is sometimes done by older scholars), but it should be possible to have the colour cheerful and pleasant to commence with, while the class might be encouraged to bring prints or reproductions of pictures with which to adorn the walls. The placing and arrangement of the pictures might also be left to members of the class, instead of being undertaken by the teacher. The collection should not be allowed to remain too long on the walls, but should be replaced by fresh ones from time to time, otherwise they lose their novelty, and the children will look at them without actually seeing them. It is an excellent plan to arrange for pictures bearing upon the particular art or craft which is being dealt with to form the picture gallery for the time being. If the

children be encouraged to bring pictures in this way, a good deal of illustrative material will be at hand for the lesson, while the look-out for particular illustrations will stimulate their interest in the subject in hand. Flowers too should be used to adorn the schoolroom, purely for their æsthetic value, and not because they are useful for botany, and again the scholars should bring them, and also arrange them about the room.

Wall Treatment

Wall-papers and the treatment of the walls form an interesting topic for discussion and investigation. At first, doubtless, the wall was allowed to remain bare, just the stone, mud, plaster, brick, or whatever it was made of. Then tapestries were introduced to add to the comfort or beauty of the room. The Bayeux tapestry which is supposed to have been worked by Queen Matilda and her ladies somewhere about the end of the eleventh century is a wonderful example, as it contains the best illustrations we have of the things of that period. Painted decoration has also been employed from early Egyptian times right down to the present day, by every nation with any claim to civilization.

Tapestries.

In the ruins at Pompeii many examples of mural painting have been discovered, which were executed either in encaustic (colour mixed with wax) or in fresco (which is applied to the wet plaster). "Fresco" is simply the Italian adjective for "fresh," and means painting upon fresh, or damp plaster, so that the colours and the plaster upon which they are placed may dry together. Michael Angelo and his contemporaries did a wonderful lot of mural decoration in fresco. In fact the earlier history of the Italian painters would be practically unknown but for their frescoes. Browning, in "Old Pictures in Florence," regrets the fact that many of these paintings have been allowed to "peel and drop," and wonders whether the soul of the artist stands watching with pain the decay of his work.

Wall Treatments.

"A lion who dies of an ass's kick,
The wronged great soul of an Ancient Master"

as he phrases it.

Wall-Papers. Wall-papers were introduced in the seventeenth century, and have to a great extent supplanted all other methods of wall covering. Distemper is more popular than it was, because many excellent preparations are procurable, but wall-paper still holds the field. Most papers are printed from rollers by machinery, though for better-class work blocks are used, being printed by hand. The size of the "repeat" in a wall-paper design is usually 21 inches by 21 inches, which means that the printing surface of the roller is 21 inches in width, and 21 inches in circumference. In the design lesson we touch upon repeating patterns, and after a few exercises of the type suggested, the children will better understand how the pattern "repeats" without obvious breaks or obtrusive lines. Books of patterns can be obtained from a friendly decorator, and will materially assist in making this clear.

After the design has been prepared, the rollers from which it is to be printed are made. The pattern is outlined with brass, which is driven edgewise into a wooden cylinder, so that an edge of brass is left standing which follows the contours in the pattern. The forms enclosed which are to be printed are then filled in with felt. Each separate colour requires a roller to itself as the inking is done by other rollers which distribute the colour uniformly and evenly. Needless to say, great care is needed in the preparation of the rollers in order to ensure correct registration and to prevent one portion from overlapping another. As the paper is *Printing.* printed in continuous lengths, the rollers record an impression at each revolution, so that inking and printing proceed automatically and regularly. After printing, the paper passes through heated rooms, being carried along on rods through the drying chamber, from whence it returns, to be rolled into standard lengths and finally packed for distribution.

There are many types of wall-paper, ranging from very cheap (and often nasty) to the most expensive (which may be tasteful, or merely ostentatious and costly). Cheap papers frequently have festoons of roses, or other flowers, naturalistically treated, tied up with flimsy looking ribbons, and the effect is disquieting and gaudy. The colours, too, are often crude and clashing. Other papers are designed to imitate leather, silk, or satin, or tapestry, while others again are camouflaged as wood panelling, or modelled plaster. All of which are doubtful from the æsthetic standpoint, because they are not what they seem.

Wall-papers, treated frankly as such, can be beautiful enough, without making them masquerade as a more costly material. Tapestry is beautiful, so too are the patterns of silks and satins; wood is an excellent material for panelling walls, while modelled plaster is good in its proper place. But to imitate any of these things in printed paper is a poor deception, and nothing more. ***Imitation.***

Another point worth considering is the decorative *motif* employed. Some elements are not suitable for frequent repetition, in fact the more interesting and stimulating they are, the more drearily monotonous they become when repeated *ad lib.* over a large surface. The human figure, animal or bird forms, flowers or foliage, treated naturalistically, are all doubtful material for wall-paper design. If used at all, they should be highly conventionalized and treated as pattern rather than in the pictorial style. The landscape frieze, which gives us the same scene, at stated intervals, each one the exact counterpart of all the rest, becomes very tiresome when repeated round the room.

Graining when executed to make a cheap wood look like oak, walnut, maple, mahogany, or other more expensive timber is not to be encouraged. Even the cheapest woods have a distinctive beauty of their own, which is worth preserving. Staining and polishing, any method which preserves the beauty of the grain and the quality of the material, is preferable to daubing over ***Graining.***

its surface with an opaque, clogging pigment. If we must have graining let it be brush graining pure and simple, with a pattern or texture evolved frankly from the use of the brush and the pigment. It is more honest, and more artistic than the feeble imitations of more expensive woods which the grainer foists upon his victims. To the average painter and decorator this is rank heresy, but to the unbiassed and reasonable mind, it is sound sense.

Exercise. Linoleum Printing. In order to make the printing of a wall-paper more clearly understood, especially the block-printing method, the children should be allowed to cut a simple decorative *motif* from linoleum, and to print it at regular intervals upon a sheet of damp paper. The method is described under "Linoleum Cutting and Printing." Stencilling is another legitimate method of wall decoration, and a few exercises in this might be undertaken. This again is described elsewhere.

Materials

Oils, Colours, etc. Painting introduces the oils, colours, etc., which are generally employed for this purpose. Linseed oil is the most widely used, and as its name suggests is a vegetable oil extracted from linseed. It is an excellent binding medium, but being somewhat slow drying, it is generally used in conjunction with turpentine, which is more volatile, and often some form of driers as red lead, sugar of lead, or litharge.

Linseed Oil. The seed is first bruised by being passed between two crushing rollers, and after being crushed falls into a box beneath. If this preliminary bruising was not done the seeds would have a tendency to slip from the rolling grindstones. They are next placed upon a bedstone, over which two stone rollers run in a circular path, and are ground to the requisite degree. The result is a paste-like mass which is placed in a press and a small quantity of superior oil extracted. The bulk of the oil is obtained, however, by heating the seed in a rotating vessel, which keeps it on the move while steam or other form of heat

is operating upon it. From the rotating vessel it passes into a number of bags, which are suspended from the lower part of the vessel. The bags are piled one upon another in iron cases, and are put into a hydraulic press, which forces the oil through the bag and allows it to trickle into a waiting receptacle. The bags are stripped from the cakes, which are again ground to powder, heated, and pressed to extract the remaining oil. After this the spent cake is used for feeding cattle or sheep, failing which it is used as manure, so that the whole of the linseed is useful for some purpose or other.

Turpentine. Turpentine is extracted from pine trees, common turpentine from the Carolina pine in America, the best from another species grown in Cyprus, Venice turpentine from the larch, etc. Strasburg turpentine is, or was, obtained by the Italian peasants from the fir forests in the Alps. Towards August they proceed to the wooded regions carrying sharp-pointed pouches called "cornets," and tin vessels suspended from their girdles. With these they climb to the summits of the loftiest firs by means of cramping irons which are fixed to their shoes. The resinous fluid is contained in small blisters just beneath the outer surface of the bark, and the peasant drives the sharp point of his "cornet" into these blisters. The turpentine flows into the cornet which is emptied into the tin vessel slung to his waist. After being strained, to remove bits of bark, moss, or other impurities, it is ready for use.

Venice turpentine comes from the trunks of trees which grow in the mountain valley between France and Savoy. The full-grown larch tree is pierced with an auger about an inch in diameter, beginning at a height of three or four feet, and mounting to ten or twelve feet. The south side of the tree is generally chosen, and the holes bored in a slanting direction so that the turpentine may flow more freely. To the holes are fixed gutters made of larch wood, an inch or so in width and about eighteen inches long. To one end of the gutter a peg is attached through which a hole is bored. This peg

is inserted into the hole in the tree, and the turpentine flows through the hole in the peg, along the gutter, into a vessel awaiting it at the foot of the tree: morning and evening the peasants pass from tree to tree removing the full vessels and replacing them with empty ones, and from May to September the woods present a busy scene. A full-grown larch yields seven or eight pounds of turpentine.

Common turpentine, which comes from Canada and the United States of America, is also extracted from the tree by means of incisions. In its natural state there is a large quantity of resin in the turpentine which needs separating before it becomes the "spirit" or "essence" used for oil paint. The stiff, honey-like paste is placed in a large distilling vessel, and exposed to heat in order to vaporize the spirit, which then passes through a refrigerator or cooling vessel into a receiver. This is the turpentine in common use, while the residuum is either black or yellow resin according to the type of tree from whence the fluid was drawn.

Pigments. The pigments are of mineral, vegetable, or organic origin. The whites are mostly lead or zinc, both metallic, and one or the other occurs in most forms of paint.

The earth colours are the ochres, umbers, and siennas, while limes such as lime blue, and whiting (carbonate of lime) are also employed. The chromes, cadmiums, Venetian red, vermilion, Prussian blue, and emerald green are preparations of metals. Coal tar gives us a variety of analine colours. The blacks are usually carbon, as lamp-black, charcoal, graphite. Indigo, crimson lake, the madders, sap green, etc., are vegetable colours.

Vasari attributes the invention of oil painting to Jan van Eyck, or John of Bruges, as he calls him, but as the art was practised long before his day, 1385–1441, it is doubtful whether he did more than improve upon existing methods. Theophilus, writing somewhere about 1100 A.D., described the technique of painting in oils, as

did Cennini also, while other records and accounts prove that colours ground in oil were employed during the thirteenth and fourteenth centuries.

Distemper. In ordinary distemper, the colours are mixed with glue size, which acts as a binding medium. Other special preparations are obtainable in great variety, a number of which are washable, and as a rule they make excellent wall coverings. For tempera painting, which is sometimes used for wall decoration, yolk of egg is the only medium employed to bind the pigment.

Sgraffito. Sgraffito is another form of mural decoration, used in churches and public buildings. It consists of a series of thin layers of plaster differing in colour, placed one upon another. With a sharp tool the decorator scrapes away the coats of plaster until he arrives at the colour he wishes to expose. He draws the desired shape upon this by cleaning away the layers above, and then proceeds to the next shape and colour, until his design is complete. It calls for a simple, conventional treatment, as the colour scheme is laid upon the wall, one tint at a time, and the decoration achieved by scraping away the intervening tint. Some of this information may seem a trifle technical, but the teacher is the best judge of what the child should be taught, and he can select what he thinks best to impart to them.

CHAPTER II

ENGLISH ARCHITECTURE

English Architecture. A KNOWLEDGE of the characteristic features of English church architecture adds much to the interest and pleasure of an excursion into town or village. As previously mentioned, the history of each epoch is engraved upon its architecture, and if there was nothing more to recommend it, the mere fact that this building or that was in existence at the time of the Norman invasion, or when Richard Lion-heart was King, or some historic event took place, the glamour of romance thus imparted to them would make it worth our while to find out about them. It would seem that a scheme of education which aims at anything approaching completeness should include at least a slight acquaintance with the buildings of our own forefathers, for in them is expressed some of the thoughts which in the course of time has expanded into the thought of to-day. To thoroughly appreciate our own period we must know something of its predecessors. The features which characterize each period of English architecture, up to the end of the Gothic at least, are fairly well marked.

Saxon. Saxon work, of which but few examples remain, is notable for the general rudeness of its masonry, and its decoration of flat strips of stone projecting from the surface, reminiscent of wood construction—Fig. 11. Herringbone work, as it is called when the stones are laid aslant, the rows sloping in alternate directions, instead of being bedded flat, is another feature of this period. The arches are semicircular, though some small openings have triangular heads, formed of two straight stones placed on end, and meeting at the apex. The few

examples which remain are mostly towers, without buttresses, and ornamented with the flat stone decoration already mentioned.

Norman. The Saxon work gave place to the Norman, which is massive, with semicircular headed arches and doorways, while its decoration is the cable, chevron or billet, and lozenge mouldings, beak heads, etc.—Plate 6, Fig. 5. It is a development of the Romanesque style, with distinctive features to differentiate it from the styles of other countries, making it peculiarly English. Norman architecture was introduced by Edward the Confessor, who himself founded Westminster Abbey, and lived to see the choir and transepts completed before he died in 1065.

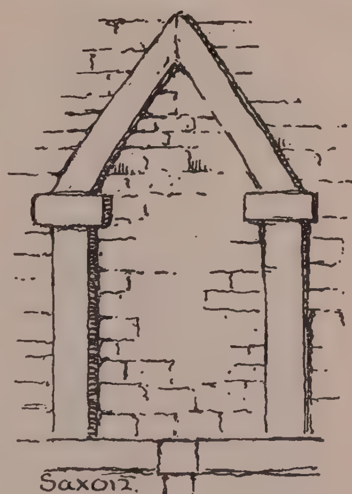
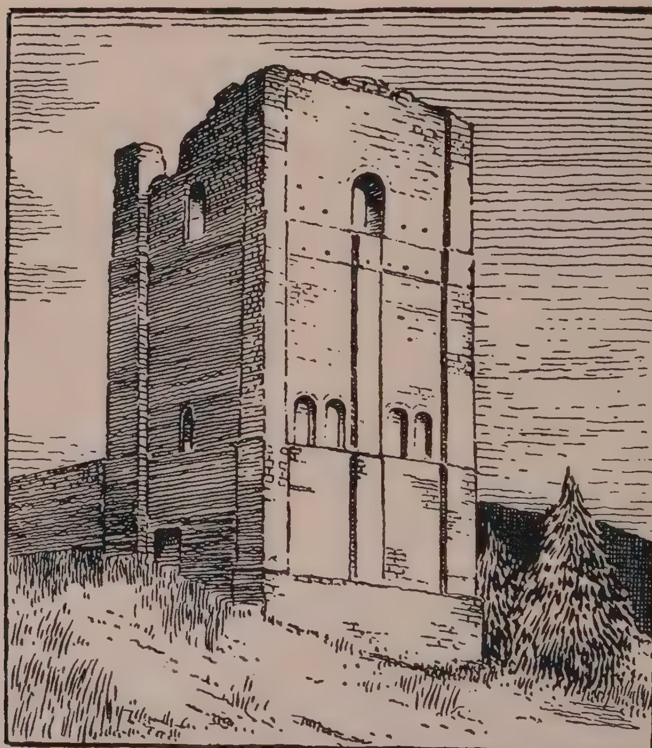


FIG. 11.

After the Norman Conquest many of the churches were rebuilt by the first Norman bishop, sometimes on the site of an older one which was pulled down piecemeal as the new work progressed. Sometimes a new church was built and the relics removed with great pomp from the earlier one, which was then demolished. In other cases, as at Norwich and Peterborough, the cathedral was erected in a town where no church had previously existed. These churches were larger and more magnificent than those they displaced, as the Norman masons were more skilful than the Saxon. Gundulph, Bishop of Rochester, was the best known architect of the time of William the Conqueror. He built the keep of his own castle at Malling, in Kent (Fig. 12), that of the castle in London known as the White Tower, and the cathedral of Rochester. Peterborough was begun by John de

Seez in 1117, and consecrated in 1143. The nave of Norwich was built between 1122 and 1145. In Canterbury Cathedral the work of Prior Ernulf was completed in 1130, and a part of Rochester, where Ernulf was now bishop, in the same year. The crypt, nave, and part of



Norman Keep, Malling, Kent 1070.

FIG. 12.

the transepts at Gloucester, the choir and transepts of Durham, the nave and transepts of Christchurch, in Hants, and the choir and transepts of Norwich were built in the reign of William Rufus. Ely, Rochester, Norwich, Canterbury and several others were dedicated during the first twenty years of the twelfth century,

while Tewkesbury Abbey, St. Bartholomew's, Smithfield, the nave of Durham, the choir of Peterborough, Reading Abbey, and St. Botolph's, Colchester, were commenced.

In early Norman work the axe was more frequently used than the chisel. The carving is consequently shallow, while another feature which distinguishes it from later work is its wide-jointed masonry. Later work of this period is more finely jointed, while the carving on the doorways is remarkably rich. The

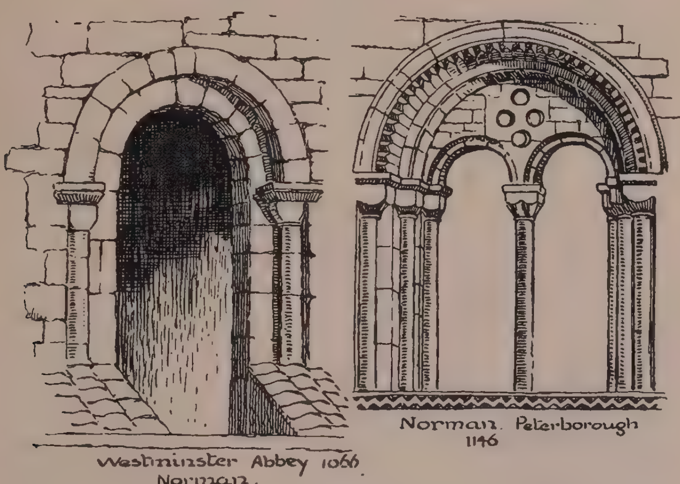


FIG. 13.

windows are usually long and round headed, sometimes with two lights divided by a shaft under one arch—Fig. 13. Some fine circular windows with wheel-like divisions belong to this period, though windows are more rare than doorways, as they have been destroyed to make room for others of later date. The piers in early work are either square masses of masonry, sometimes recessed at the angles, or simple round massive pillars often without caps. They grew less massive as time went on, and were sometimes carried to a considerable height, as in Gloucester cathedral. The caps at first are cushion caps, just plain cubes of stone with the lower angles

rounded off—Fig. 13. Later they were frequently ornamented with groups of figures, foliage, and animals. The abacus, or crowning member, is fairly constant throughout, being square in section with the lower part

FIG. 14.

chamfered off either straight or slightly concave. The bases to begin with were simply a quarter round moulding, then two quarter rounds, sometimes with a chamfer between, becoming more elaborate as the style advanced. The towers are low and massive, rising but little above

the level of the roof. An arch and a doorway are shown in Figs. 14 and 15.

There is a transition period when the Norman was

FIG. 15.

merging into the Early English and we find the features of both periods mixed up together. Some authorities hold that the lancet arch, a distinguishing feature of Early English, was evolved from the interlacing of round-

headed Norman arches. Some of these overlapping arches still exist, but we cannot say definitely whether they led to the Early English. These lancet windows (Fig. 16), are more characteristic of the early part of the style, from about 1190 to 1220 or 1230, after which

Early English.

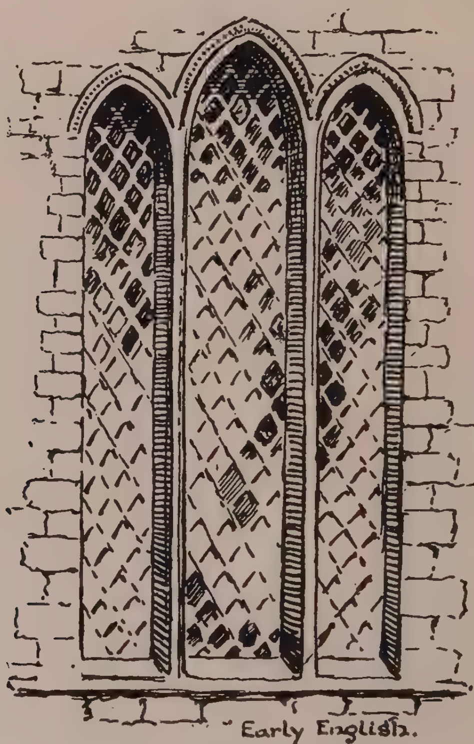


FIG. 16.

circles appear in the tracery of window heads of two or more lights and the circles became foliated about 1230. Square-headed windows sometimes occur especially in domestic architecture. The early work is known as "plate tracery," because it is practically a plate of stone pierced—Fig. 16. The later was moulded, forming as it were continuations of the mullions, and is known as

"bar tracery." The arches are often acute and richly moulded, but the form of the arch is not so safe a guide as the mouldings. The pillars are generally octagonal, or round, and often clustered, the most characteristic being the detached group of Purbeck marble columns united at cup and base. The foliage of the period is quite distinctive; Fig. 17 is a typical example. The

FIG. 17.

caps are shaped like an inverted bell ringed with mouldings at the abacus and neck. The bases usually consist of two rounds, sometimes filleted, with a deep hollow between. The mouldings are bold rounds with deeply cut hollows between, giving a strong effect of light and shade. The "dog tooth" ornament (Fig. 5, Plate 6), is as typical of Early English as the "zigzag" is of Norman—Plate 6, Fig. 6. Crockets were intro-

duced during this period, and the flying buttress becomes a prominent feature.

The towers are loftier than Norman, while the buttresses have a greater projection. Often there is a spire, and pinnacles enrich the angles of the tower. Salisbury Cathedral, a fine example of Early English, was built between 1220 and 1258. Christ Church Oxford, Rochester, Worcester, York, Durham, Ely, Lincoln, Fountains Abbey and the Temple Church London, also contain typical work of this style.

Decorated. Again we have a period of transition from Early English to Decorated. In early Decorated the human figure was used with much freedom and vigour, while the treatment of the drapery accords well with the figures it veils. The Eleanor cross at Geddington is one of the most perfect examples yet existing. The doorways are often large with a rich canopy above decorated with crockets and finials. Sometimes, however, they are plain, with just a dripstone over them. The windows are large, with either geometrical or flowing tracery in the heads, and are divided by mullions below. Those at Exeter Cathedral, dating from 1279 to 1291, are all geometrical. Later on the tracery became flowing and even flamboyant (Fig. 18), though in England we have no examples of true "Flamboyant" tracery such as may be seen on the Continent. Square-headed windows are by no means uncommon. The pillars are clustered, with caps often decorated with foliage, though in many cases they are quite plain. The foliage is excellent in treatment, and as a rule made to encircle the cap. The bases are more often simply moulded, and rest upon a plinth. The mouldings are not so deeply cut, or so vigorous as in the Early English. The roll moulding, the ball-flower (Fig. 5, Plate 1), and the four-leaved flower (Fig. 5, Plate 1), are the most characteristic decorations of the period, which is generally regarded as the culmination of the Gothic.

The towers generally terminated in a spire as in the previous style. The nave at York, the lantern at Ely,

and the three spires at Lichfield are good examples of Decorated architecture.

Perpendicular. Another period of transition, we might almost say decline, brings us to the last of the Gothic styles, the Perpendicular. This style is peculiarly English, and is never found on the Continent. Its main distinction lies in the form of the tracery in the window heads—Fig. 19. The rigid lines of the mullions are carried right through

Fig. 18.

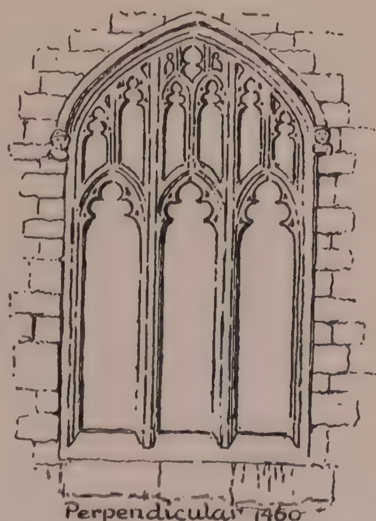


Fig. 19.

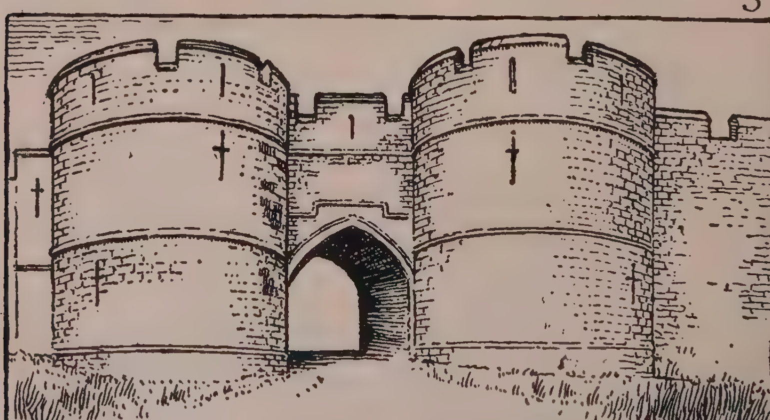
and the spaces between are often divided with perpendicular lines, hence the name "Perpendicular." The whole external surface of a building was often panelled, and the lines of the panelling were mainly vertical. For domestic architecture it is a more suitable style than either of the earlier ones, and a number of houses erected during this period still exist—Plate 20, Fig. 2. The arches become less acute than before, growing still more flat as the style draws to an end. The mouldings become more shallow, as, in fact, does the whole carving generally.

1

Half-timber "Unicorn" Shrewsbury.

2 Rockingham.

3



Rockingham Castle.

PLATE 20.

The doorways are often a depressed arch within a square frame, over which is a label with the label-moulding frequently filled with foliage.

The towers are generally extremely elaborate and richly decorated, having four or five stories, with canopies, pinnacles, tabernacles, double buttresses at the corners, and deep open parapets, with pinnacles and crocketed turrets at the angles. Somerset is very rich in these towers. That beautiful type of vaulting known as fan tracery is peculiar to this style. The mouldings differ much from those of earlier periods. They are shallower

FIG. 21.

and less vigorous in light and shade. The "Tudor flower" is a characteristic ornament. The treatment of foliage, and in fact of all ornamental features, is somewhat square when compared with the other styles of Gothic—Fig. 21. Open timber roofs belong almost exclusively to this time, while many beautiful screens, lofts, and bench ends of carved wood remain to us.

Gothic architecture seems to have reached its loftiest stage in the fourteenth century, after which the predominance of the straight line prepared the way for the Classic Renaissance. The straight line is the controlling line in Classic work, while in Gothic we have sweeping

curves, and flowing lines, marvellously arranged and stabilized by a system of thrust and counterthrust. Great masses of masonry are cleverly supported upon slender columns, and made to act and react one upon another for mutual support. A Gothic church with its large expanses of window has been compared, aptly too, to a jewelled lantern. In no other style has the arch principle been exploited to the same degree as in Gothic. There is no room here to trace the decline of this wonderful style, this "blossoming in stone," as Emerson calls it, nor to deal with the Renaissance itself.

Wren. We cannot forbear, however, to notice the work of Wren, whose splendid churches, culminating in that wonderful pile, St. Paul's Cathedral, adds so much glory to the City of London. This necessarily brief and scrappy survey is intended merely to arouse interest, and to suggest a method of dealing with those splendid treasure houses, which have been bequeathed to us in our churches and cathedrals. If possible, visits should be paid to those within reasonable distance, and the class stimulated to enquire into their history and manner of construction. Photographs and other illustrations will serve to instil a knowledge of the characteristic features of each period. Every building is a human document, whereon is written some part of the thoughts and aspirations of the race, and will, therefore, amply repay the time spent in studying it.

In order to drive home these lessons and to provide the class with work of a useful nature, a model of a church, as shown in Fig. 2, Plate 1, might be undertaken. This model might be carried out in cardboard or stout paper, or modelled in clay or plasticene. The actual medium employed is of little import, as the main object is not so much to produce work for exhibition, as to render the ideas of the class clear and concrete. Typical arches, as in Figs. 11, 13, 14, 16, 17, might also be modelled in wax or clay, in fact any exercise which tends to clarify the conception and to provide valuable occupation for hand and brain is worth undertaking. The

characteristic ornaments of the various periods might also be essayed.

An excursion into a wood or forest would help the children to draw a parallel between the columns and the branching groins of the vaulting, with their foliated ornament, and the trees which constitute the forest. Anyone who has traversed a path through trees must have been struck by the similarity it bears to a Gothic church. Emerson says, "The Gothic church plainly originated in the rude adaptation of the forest trees, with all their boughs, to a festal or solemn arcade, as the bands about the cleft columns still indicate the green withes which tied them. No one can walk in a road cut through pine woods without being struck with the architectural appearance of the grove, especially in winter. . . . In the woods on a winter afternoon one will see as readily the origin of the stained-glass window with which the Gothic cathedrals are adorned, in the colours of the western sky seen through the bare and crossing branches of the forest. . . . The mountain of granite blossoms into an eternal flower with its lightness and delicate finish, as well as the aerial proportions and perspective of vegetable beauty."

This similarity between nature and Gothic art struck me particularly when first I entered a fine beech avenue in the Dukeries in Nottinghamshire. On either hand rose the smooth grey boles of the beeches, swelling out into cap-like forms, from whence spread the branches which arched overhead. The roots based the columns, while a smooth floor of warm-coloured beech-mast stretched between the colonnades. Far down the avenue, an arched shape of sunlight gleamed like a stained-glass window. Above, the vaulting of branches was roofed with grey-green foliage. Here and there splashes of sunshine fell upon the columns, transmuting their grey to gold, or lay upon the floor of beech-mast in pools of crimson and orange, while above as it caught the foliage the sunlight turned the grey-green into emerald and glowing green. It was

soft and mysterious, for the sunlight which filtered through merely served to accentuate the "dim religious light." Loftier, wider, and deeper, than any building raised by man, one could hardly fail to be awed by its solemnity. A "Cathedral aisle" was the one simile which would recur to me, though even this seemed banal and inadequate when applied to this long, lovely perspective of stately beech trees. It was easy to imagine that in some such forest aisle the Gothic builder found his inspiration. A reawakened interest in nature, and a deeper and loftier conception of God's immanence, easily explains the desire of the craftsman to build after the fashion of nature's God. Bearing in mind the limitations of stone, and the laws which govern its use, it is not difficult for the imaginative mind to trace the parallel between Gothic architecture and the architecture of the forest. A study of the foliage used in church adornment helps to render the parallel still more clearly marked.

Domestic Architecture

Dwellings. Another interesting branch of this subject is the study of such historic buildings as may be in the neighbourhood, or of which pictures may be obtained, and by means of these trying to trace the evolution of domestic buildings. There are ruins of castles in many parts of the country which will furnish useful material for a beginning.

Castles were built originally as fortified dwellings, wherein the feudal lord with his family and certain of his retainers might live in some degree of security. In the "Good old days" the rule was that "He shall take who has the power, and he shall keep who can." Daring and skill in warfare were rewarded in those days, and the man who was strong enough helped himself. Having seized what he wanted he must needs take the necessary precautions to keep it from others who desired it also. No police force existed to uphold the rights of the citizen, it was a case of every man for himself. If

powerful enough he became a lord, or possibly even a king, and unto him came lesser lords and nobles banding themselves together under his leadership for mutual benefit and protection. Each of these lords and nobles had other men of still less importance at his command, and so on down the scale until the serfs or poorest of all were reached. These men, each in his own sphere or capacity, served those above them and were all prepared to do battle at the command of their overlord, who in turn gave them some measure of protection. Thus certain nobles obtained command over certain districts and erected castles therein. Here they dwelt and lorded it over the countryside, and here they were often besieged by other warlike nobles jealous of their wealth and power. Hence we find these ancient castles strong, massive, and well guarded.

Situation. They were generally built upon a hill-top or other eminence and were surrounded by a moat, over which a drawbridge was lowered when the inmates or friends wished to cross. The gateway behind the drawbridge was defended by a portcullis which could be dropped when necessary, barring all access from the outside, even to those who had crossed the moat. The gateway was flanked with towers pierced with long narrow slots from which the archers or cross-bowmen launched their feathered shafts or bolts at the enemy—Fig. 3, Plate 20. These slots were very narrow on the outside of the massive wall, but widened considerably towards the inside to allow the marksmen a more extended range, while leaving but a small entry for missiles aimed from the outside. The walls were battlemented in order that the defenders could hurl stones or other projectiles upon the besiegers while they themselves were to some extent protected. Bartizans or small projecting towers often occurred at the angles of the walls for defensive and look-out purposes. Machicolated battlements projecting from the wall are often seen, from whence boiling lead was poured upon the enemy beneath.

Bailey. Inside the walls was a large enclosed space or bailey,

where were the stables, granary, barracks for soldiers, and other necessary buildings. The keep, or castle proper, was on the highest ground (Fig. 12), so that the sentry who kept watch from the top could see over the surrounding trees, which were more plentiful then than now.

Moat. The moat was generally carried round the keep as well as round the outside walls and a further drawbridge and portcullis defended it from attack. If the enemy managed to carry the bailey by assault they had still to cross the moat guarding the keep, and pass the gateway into it, during which time the defenders would be launching bolts or arrows, and pouring stones and molten lead upon them. The well was in the keep so that the water supply was safe in case of siege. The walls of the keep were about ten feet thick, and in these walls were small rooms which served as bedchambers for the members of the family, while the servitors slept on the rush-covered floor of the large central hall, around which the smaller rooms were grouped. The windows of the great hall were closed with shutters at night, or when the weather was very bad, but otherwise they were open to the winds.

Castles figure largely in fairy tales, for the prince and princess always dwelt in some beautiful castle, or found themselves in one when their troubles were over, for the castle is an essential part of the "Happy ever after" period. "Castles in Spain" is a well-known phrase. A model of a castle will make a fascinating exercise and it can easily be fashioned of stout paper, thin card, clay or plasticene—Fig. 4, Plate 6, Fig. 3, Plate 20, are illustrations of the type of thing which may be undertaken.

Roman. Long before the Norman castles were built, there were Roman villas in Britain; and from the foundations and tessellated floors which have been excavated it is possible to obtain some idea of the Roman residence. It usually consisted of a sort of state apartment or reception-room called the atrium. This was entered by

way of the ostium which lay between it and the door or vestibulum. The ostium was a long room generally with a tessellated floor, and containing statuary or trophies of war. Behind the atrium was the tablinium, a sort of recess, while behind again was the peristylium, an open court surrounded by a colonnade and set with shrubs, trees, and flowers, while sometimes a fountain occupied the centre. At first rough stone and sun-dried bricks were used. Later on dressed stone faced with marble was employed. Rubble work of coarse gravel and concrete, often faced with stone, or fired bricks, came still later, together with roofs of tiles. Charcoal *Heating.* braziers heated the smaller houses, while the more important ones had holocausts or furnaces with tiled flues carrying the hot air to the chambers where it was needed. Bulwer Lytton's *Last Days of Pompeii* describes the residences of the Romans.

Anglo-Saxon. The Anglo-Saxon house was usually of wood built on a foundation of stone, and either thatched or tiled. There was a large room or hall, with the bedchambers, kitchen and offices grouped about it, and the whole enclosed within a bank or close-set hedge.

Fifteenth Century. This plan of the large hall with the other rooms grouped about it remains in vogue until we get to the fifteenth century when the arrangement becomes more like that of modern houses. There is more accommodation and more small rooms, so that greater privacy could be enjoyed by the members of the family. The architecture of the houses up to now has been similar to church architecture, except perhaps in the castles, which were also dwellings, but in which the necessity for defence led to more massive treatment. From now on there is a more distinct type of architecture for domestic purposes. Fig. 2, Plate 20, is an example of domestic building, though even here there is still a hint of the church style. Perpendicular, as the square-headed windows with their stone mullions and transoms, and the projection of the buttresses would suggest.

Houses of this type are very numerous, especially in

Cotswold Houses. the Cotswolds, where, built of the local stone which weathers a charming colour, and set among the rich verdure in the valleys, or upon the windswept hillsides, they are fraught with a sense of comfort, of peace and durability which is a delight to the eye, and also to the mind of the observer. In the sunshine they are a rich golden brown, beneath a grey sky they appear grey though warm, but always they belong to the landscape; they seem an essential part of it. Never do they offend the eye as red bricks and tiles sometimes do, or new freestone, or fresh whitewash before time has laid its kindly, softening hand upon them. The Cotswold stone is quarried in the hills and the houses built of it partake of the very nature and essence of the district, which possesses a characteristic charm all its own. The roofs, too, are generally of stone, though sometimes thatch occurs. Most places have their own peculiar beauties or characteristics, sometimes unfortunately, as in some industrial areas, they are mainly characteristics; the beauty is hard to find.

Half-timber. Half-timber houses date mostly from the sixteenth and seventeenth centuries—Plate 1, Fig. 1, Plate 20, Fig. 1. Oak was the principal timber, though elm, beech, and sweet chestnut were sometimes used. A foundation wall of brick or stone was first laid, upon which was erected a stout framework of posts eight or nine inches square. At the angles still heavier posts were used. Across these were laid horizontal beams, projecting some eighteen inches over the framing below, with floor joists tenoned to them. The upper story was constructed in a similar manner. The spaces between the uprights were filled in with other vertical posts about nine inches wide with spaces between about the same width. These spaces were treated with wattles or laths, covered with clay and chopped straw, finished with plaster flush with the woodwork. Brick and stone were also used for filling in. The Fire of London made the use of wood somewhat unpopular, though half-timber houses were erected

long afterwards in certain districts. Many examples of these houses still exist, and are worthy of study, for they are decidedly picturesque. Most towns, and many villages, have interesting houses which are worth a visit, while scattered about the country are many others around which interesting talks might be centred.

Castles. There are quite a number of castles still existing in various states of preservation, each of which has a history all its own. Windsor, Donnington, Oxford, Winchester, Wells, Kenilworth, Warwick, Berkeley, Exeter, Dartmouth, Ludlow, Stokesay, Chepstow, Raglan, Harlech, Conisborough, Lancaster, Sterling, Dunluce, Edinburgh, and Richmond are just a few out of the many which have played their part in history. *History in Buildings.* There is a vast store of material in such buildings as these for the teacher who would base his historic lessons upon the architecture of the people and the country he is dealing with. Many of these castles are in ruins, but often enough remains to show how imposing they must have been in the days when they were called upon to withstand the attacks of besieging foes. The massive walls, eleven feet thick in some cases, were built to endure the assaults of battering-rams and other such engines of war, and have crumbled but slowly beneath the levelling hand of time. Some idea of their strength and solidity may be obtained from Fig. 22, drawn from an old wood engraving of Carlisle Castle. There is always an atmosphere of romance about these old erections, which even in their ruined state cannot fail to impress the mind of the child, and useful comparisons might be drawn between the ancient and the modern.

In the days of castles, the weapons were of such a nature that the castle dwellers could feel comparatively secure. Nowadays the weapons are so vastly improved, or shall we say developed, with such fiendish skill and power that no building erected by man can be expected to stand against them. The only hope lies in mother earth, so man digs trenches and piles up ramparts

of soil so that the projectiles may lodge therein, and so perhaps become harmless before it reaches the burrowing mortal. Even here, however, he is not very safe, for explosive shells are capable of blowing even trenches into the air, and the men who shelter there are often reduced to fragments. It would seem wiser to think not of war but of peace. Thought is a powerful factor in the affairs of man, and if we desire peace, and decide to bring it

FIG. 22.

about as far as we are able, we shall at least add our quota to the abolition of war as a means of settling disputes between nation and nation.

Construction is always of greater value to the race than destruction, and in our lessons on the Industrial Arts we are concerned with construction. Stripped of all the fictitious romance with which we have seen fit to surround it, war is an ugly, brutal business at its best. If we could see it clearly, shorn of its glamour, its panoply and trappings, in the cold light of reason, undisturbed

War.

by martial music, slogans and pseudo-patriotic catch-phrases, we should despise and detest it. Yet, strangely enough, boys are educated in order that they may follow it as a profession. Teachers have a great responsibility in this matter, but often they fear to speak freely and candidly for fear of being deemed unpatriotic. It is truer patriotism to work and to think for the good of one's fellows than to contemplate killing or being killed by them, even though they may belong to a "foreign" nation. We may not be able to prevent war as yet, because there are too many who desire it, who are enriched or exalted by it, but we can at least believe, and lead the young to believe, that peace is infinitely preferable. If all men desired peace war would be impossible, hence if we can help to mould the thoughts of future generations so that war is held in abhorrence we shall be helping towards the abolition of so primitive, so brutal, and so utterly futile a method of bringing disputes to the issue. For it does not settle them, it merely subdues the weaker party for the time being, leaving a desire for revenge rankling in the mind, awaiting the day of vengeance, and the only hope of peace lies in the victor maintaining his superiority. Surely we have passed, or should have passed, this primeval stage after so many centuries of so-called civilization. However, our castles were built for warfare, and considered from this point of view are worthy of interest.

Power of Thought.

Our excuse for this seeming digression is that if we cannot learn the lessons that history would teach us, then all that man has done, and thought, and been, is in vain, so far as we are concerned. Also we are contributing our share to history, which will be recorded by future historians, and if it is unworthy, then it were better that we had not lived. Regarded as structures, as examples of the builders' craft, these castles are fascinating enough, especially when compared with modern erections, built not to endure but merely to meet immediate needs—Fig. 23. Stokesay Castle shows

a structure of half-timber upon the walls of an older building. Here we have two styles or periods in the one example. In ecclesiastical architecture this is often

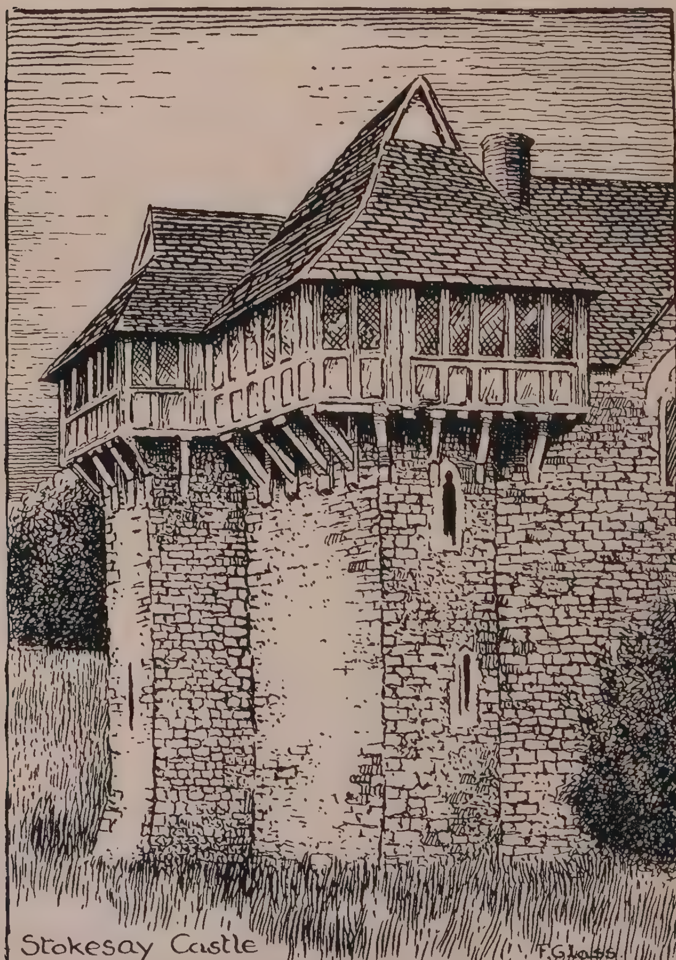


FIG. 23.

the case, for in many of our churches, and most of our cathedrals, there is Norman, Early English, Decorated, and Perpendicular work all represented.

CHAPTER III

FURNISHINGS

THE next subject to be considered is the furniture, which plays so important a part in the home. Tables, chairs, couches, stools, bedsteads, desks, book-cases, and all the rest, will provide much material for investigation and discussion. Furniture is invariably made of wood, which in itself opens up a wide vista. Timber is obtained from trees, which are amongst the most beautiful as well as the most useful of nature's products. There are many species, quite a number of which furnish material for woodwork, though oak, walnut, mahogany, beech, birch, deal, pine, elm, and satinwood, are perhaps the most commonly used. There are other woods which occur less frequently, as ebony, box, maple, cedar, amboyna, lignum vitæ, etc., while ivory, tortoiseshell, brass, and other materials are used for decoration. A tree is a wonderful structure, rooted in the soil, from whence it draws considerable nutriment, while above rises the bole, crowned with branches which taper down to delicate twigs, with a lovely garment of foliage, which again extracts nutriment from the atmosphere. Sunshine and moisture are needed by the tree, and given a due share of these, it expands into a splendid growth. The need for sun and air causes the forest tree to stretch itself upwards towards the light, so that its trunk grows tall and straight, with foliage far above, where it can feel the sunshine.

Trees.

Trees, like all plants, must be fertilized before they can grow, and so we have males and females, while some trees are "bi-sexual," with both male and female organs in the same blossom. Some are wind pollinated, while

Pollination. others rely upon bees, butterflies, and insects to perform this duty. The pollen is produced by the male flower, and unless the ovary of the female flower is impregnated with this pollen it remains sterile. Those trees which are wind pollinated produce a vast quantity of pollen, as, scattered by the wind, a good deal is wasted, compared with that which reaches the female flowers. The blossoms of these trees are not so sweet scented, or so brightly coloured as are those which rely upon insects for pollination. The lovely colours and sweet odours of the latter have been adopted to attract these useful little carriers, who, flitting from flower to flower, and from tree to tree, to delve for the honey which lies secreted in the heart of the blossom, carry the pollen, upon their bodies, and so perform the office of fertilizing agents. Some trees shed their leaves in the autumn and are known as deciduous, while others are evergreen and retain their foliage throughout the year.

At one time this land of ours was far more densely wooded than it is to-day, but still trees are being thoughtlessly and ruthlessly felled all over the country. Yet it is an established fact that trees assist in making places habitable, and that considerable atmospheric changes are brought about by their removal. Some scheme of afforestation is urgently needed, or in the near future there will be a calamitous shortage of trees. In the early days of the world's history, before man appeared with his devastating axe and saw, the monarchs of the primeval forest rose and fell at the command of Nature. For æons this process of growth and decay continued, until in the course of centuries the fallen trees, buried beneath the soil and decayed vegetation which accumu-

Coal. lated over them, turned into coal, and peat, providing man again with indispensable commodities. We owe an immeasurable debt to trees, which we can only commence to repay when we have learned to plant for the future while we are cutting down to supply our present needs. Fortunately, there are still large tracts of forest, in some of the regions where man has not yet congre-

gated as thickly as in these isles. A world without trees would be a dreary, barren place, and we can only hope that some provision will be made for the future, by planting, and cultivating, as well as by felling them.

The need for timber keeps many men employed, and the lives of those who provide us with wood are worthy of consideration. The lumberman in particular is romantic and fascinating, because of the dangers and difficulties which beset his path. In the forests of Canada and America these men may be studied. On the Pacific Slope the trees grow to a huge size because there is an abundant rainfall and a suitable climate. In South America lumbering is a thriving industry, many of the lumber camps being busy little towns. These towns are removed from time to time as the forest, which is the reason for their existence, is cut back. *Lumber-men.*

The usual procedure is somewhat as follows: A group of men explore the forest searching for the best timber and for the easiest method of transport. Having chosen a district they " blaze " or gash the trees which mark the boundaries of the area and decide upon the location of the main camp. The rest of the company, the lumber-jacks, cooks, clerks, and a blacksmith, follow in due course with supplies sufficient to last for several months, and proceed to erect the necessary shelters.

The next important task is the construction of a wide smooth road from the heart of the forest to the railroad or river, by means of which the logs may be transported. This is not easy, as the road must be strong and stable to endure the weight of the heavy timber, while sturdy bridges have often to be erected over gulches or streams. The trees to be felled are chosen by a skilled man, who marks them with an axe on the side towards which they are to fall. Judgment and experience are necessary to make the tree fall without accident, or breakage, and to keep it from lodging in the branches of those adjacent. Large valuable trees are made to fall upon beds of brush and undergrowth, so that their trunks are not broken by *Road-making.*

impact with the hard ground. On hillsides they are thrown uphill to shorten the distance of the descent.

The sawyers next appear, and with a long flexible crosscut saw they commence cutting on the side opposite to that marked with the axe. Fig. 24 shows two sawyers at work. As the saw penetrates the trunk the weight above would tend to close the saw cut and to clamp the saw. To obviate this an iron wedge is driven into the opening with a heavy mallet. This

Felling timber

FIG. 24.

process is continued until the tree is almost severed from its base, other wedges being driven in to make it fall in the desired direction. When down, the trunk is trimmed of its branches and cut into standard lengths—see Frontispiece. The logs are then stacked in spaces cleared beside the road, known as "skidways," until the time for transport arrives. A team of horses, attached to the log by means of chains, drag it to the skidway, where it is piled with others to await removal, during which time they are measured to determine the number

of feet of timber in them, and stamped with the owner's name.

In mountainous districts the logs are taken on sleighs to the lakes, rivers, or railroads, and the horses used to draw the sleighs are often very expert in the work, as they need to be to guide heavy logs down a steep hillside without getting crushed themselves. Where the ground is more level the lumber is hauled along the roads. Winter is the most suitable time because the frost makes the surface of the road hard and smooth. The logs are piled on sleds and drawn by horses to the rail or river. At the railway they are stacked directly on the trucks and taken to the sawmills. *Sleighs.*

When the river is to provide the means of transport the logs are rolled upon its frozen surface to await the spring thaw. When this arrives the lumber-jacks don their waterproof suits and spiked shoes, and commence their exciting but dangerous work. Armed with a pole, which has a combined hook and pike at one end, known as a "peavey," they keep the logs on the move. Some of them ride the logs, springing dexterously from one to another, and maintaining their equilibrium in a wonderful manner, while they roll and propel the timber, and endeavour to prevent "jams." *Jams.* When these occur there is bustle and activity, for the longer it lasts the more difficult it becomes to remove the cause, owing to the lumber which accumulates behind. The "drivers" must find the logs which are holding back the rest, and set them in motion. If they cannot do this with their hooks, they place a charge of dynamite in the jam which explodes with a roar and enables the journey to be resumed. Sometimes jams are broken by damming the stream at the rear of the obstruction until a large volume of water has been collected. The dam is then removed and the flood sweeps forward carrying the logs with it.

On broad rivers the logs are collected into rafts, and *Rafts.* as the journey often takes a considerable time, the men who accompany them live in houses built on the raft.

Sometimes in mountainous districts the methods already described are not practicable, in which case the lumber is cut into planks and floated to the valley below in "flumes" or troughs of wood through which a stream of water is flowing. Some of these flumes are many miles in length. Generally, however, the logs are transported to the sawmills before being cut into planks, after which they are shipped to various parts of the world to provide material for carpenter, joiner, or cabinet maker.

Drying Wood. Before it can be used the wood needs to be dried or "seasoned" in order to get rid of the sap. The boards are piled one upon another with a strip of wood between to allow passage for the air, while a roof keeps off the rain and the direct rays of the sun, which if allowed to fall upon the planks would cause them to warp and crack. Fine woods are often allowed to dry for four or five years, but a much shorter period serves for rougher timber. Nowadays, however, kiln drying has been resorted to in order to lessen the period. The hot air of the kiln evaporates the moisture in a couple of weeks, which is a decided advantage in these days of competition and hurry, though the method is considered to be inferior to the open-air one.

Having acquired some knowledge of how wood is obtained, the attention of the class might be directed to the actual making of furniture. The purpose of each article and the most logical way of setting about its construction, with due regard for the nature of the wood and the tools to be employed, will furnish material for thought and discussion.

Tables. A table is primarily a board or plain surface maintained at a convenient height, upon which crockery or other articles may be placed safely and steadily, so that we may take our meals or work thereat. It must also be comfortable to sit at, allowing us to draw close without bringing our knees into contact with supporting members. Experience has proved that for rectangular tables of any size a vertical support at each angle is

best, while for circular, octagonal, hexagonal, or even small square tables a central pillar support, or four uprights properly arranged serve equally well. "Gate-leg" tables, or expanding ones of other types, are useful where space is limited. The gate-leg table is enlarged by raising a hinged leaf at either end to be supported by a leg which swings in and out in the same manner as a gate. This swinging leg gives its name to the table. This provides us with a starting point—a horizontal surface standing at the correct height, upon vertical supports. For small children, a square or oblong of cardboard or thin wood, glued or pinned to a block of wood, will form a good exercise—Plate 25. After a little experience in the manipulation of tools and materials, four uprights fixed to the corners of a thin board makes a suitable lesson—Plate 25. These can be arranged to fit the doll's house already suggested.

Chairs. A chair comprises a seat, firmly supported at the requisite height above the ground, strong enough to take the weight of the person sitting upon it, with an upright back to lean against, and in some cases a pair of arms. Sometimes the whole chair, including the seat, is made of wood, while where comfort is desired the seat and back are padded and upholstered, often with springs in the seat. These are the essentials and should be made the basis for all exercises in the study, design, and manufacture of chairs. Once again a block of wood with a strip of card or thin wood fastened to it, to form the back, is sufficient for the younger children—Plate 25. Later on more elaborate exercises can be attempted, but not until we are quite sure there will be no undue tax placed upon the capacity of the child.

Then a long bench seat as in Plate 25 might be made, followed by a settle, Plate 25, a cradle Plate 25; and a circular table with a pillar support, Plate 25, might be essayed. As skill and confidence are acquired, packing cases may be pressed into service and chairs, Plate 25, cupboards, Fig. 26, etc., fashioned from them. The advantage of using cases lies in the fact that the timber is

cut and already fastened together for a part of the work, which lessens the labour entailed, and makes the production of an article easier and quicker. This advantage

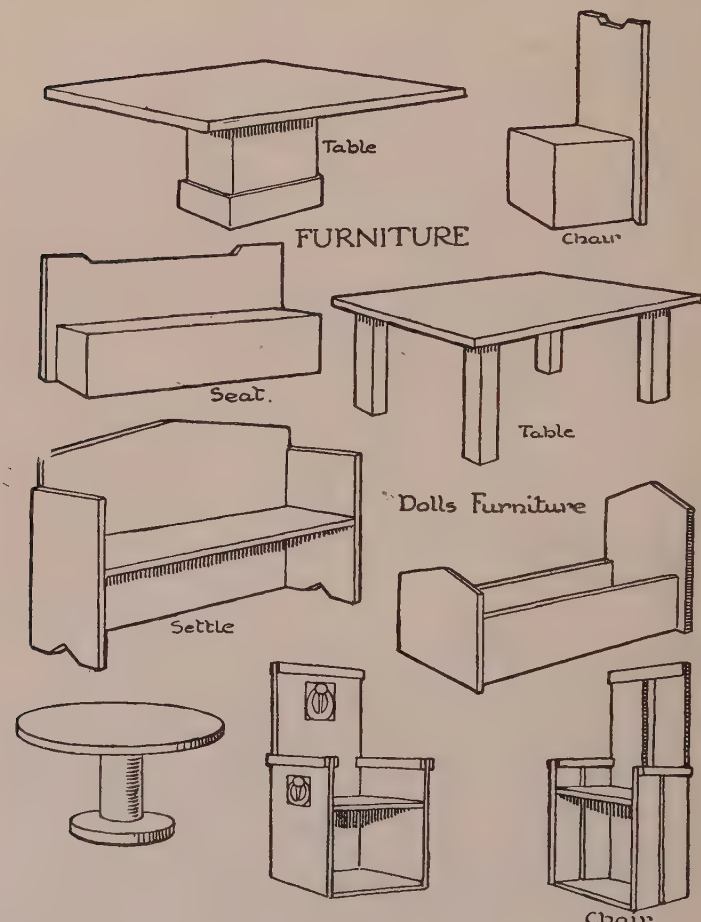


PLATE 25.

will be appreciated by the teacher who knows how readily children tire if the task set them is too arduous.

During the exercises in woodwork the scholars should be taught to realize the fact that timber is sawn into

planks or strips, and that these must provide the material for our furniture. There is nothing arbitrary or illogical about these planks and strips. They are the outcome of the nature of the wood and of the tools used in cutting it. Pictures of early-Victorian and the so-called "Art Nouveau" furniture, which ran riot a while ago, should be procured, and the lack of common sense in design

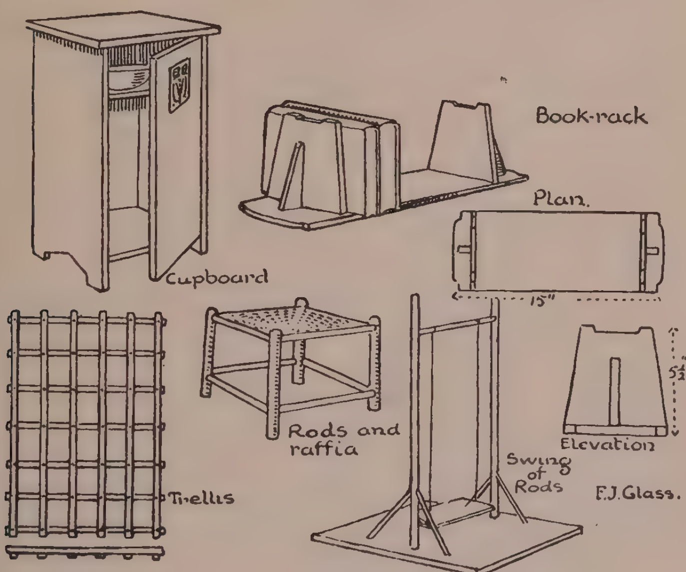


Fig. 26.

and construction displayed in their elaborate curvature and ornate scrolls, pointed out to the class.

In much of this type of furniture the absolute disregard for the qualities of the material and for the methods of working is so obvious that it provides a valuable object lesson in bad taste and ostentatious vulgarity. To counteract the effects of this and to inculcate an appreciation of fitness for purpose, and for a legitimate use of tools and materials, some illustrations of good furniture should be exhibited. Typical examples of Heppelwhite, Chippendale, Sheraton, and Adam furniture, together *Good Examples.*

with some of earlier date, and selected specimens of simple well-planned modern work might be displayed, discussed, and examined.

Tools

Tools. The use of the tools is another important item, and the children should learn what each tool is fitted for, and how it has been evolved from others more primitive. Methods of joining and fastening should be examined and experimented with where possible. Boxes or other articles might be taken apart in order to discover the manner of joining employed. The joints most frequently employed should be pointed out and demonstrated. The "groove and tongue," "dovetail," "mortise and tenon," "ploughed and tongued," and methods of fixing mitres are illustrated in Fig. 27. Glue is largely used for holding wood together, usually in conjunction with one of the types of joint illustrated, or others more complex.

Glue. Glue is made from the bones, sinews, feet, tails, and the cuttings and trimmings of the hides of animals. The best is made of ox-hide soaked in lime until all fatty and other matter is eaten away, and only the glutinous part is left. This is cleaned, boiled, and dried.

Bones are pickled in dilute acid until the lime salts are dissolved leaving only the gelatinous matter. The best glue is hard, transparent, with little or no smell, and amber coloured. If soaked in cold water it swells to a considerable extent without dissolving; in hot water of course it dissolves readily. Fish glue is prepared from the muscular tissues and the scales of fish. Isinglass is a very refined sort of glue made from the air bladder and viscera of sturgeon and cod. Liquid glue is not so strong as ordinary glue and emits an unpleasant odour, its only recommendation being its convenience.

Gluing Joints. When two surfaces of wood are to be glued together it is essential that they should be smooth and in close contact with the least possible thickness of glue between.

The glue must be used hot and the contact made as soon as the two pieces of wood can be brought together. Clamps are used to keep the joint close until the glue has set, which takes some hours. The superfluous glue is wiped off with a warm damp rag, or peeled off with a chisel, when it has thickened sufficiently.

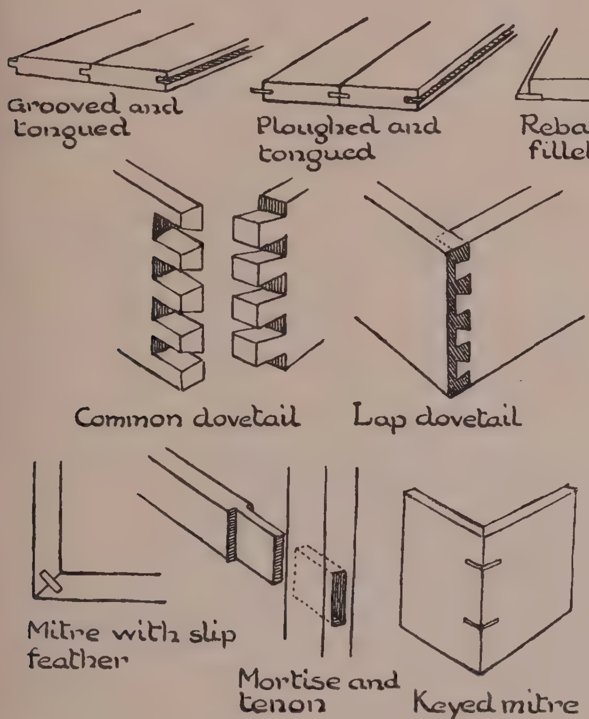


FIG. 27.

Nails and screws should be examined and the characteristics of each discussed and compared. The greater holding capacity of the screw should be noted, and the reason sought for. Nails are usually of steel, iron, copper, or brass. Sometimes the iron is galvanized to prevent it from rusting. Copper and brass are used particularly in boat building, as they do not corrode. *Nails and Screws.*

Nails are classified under three main headings, wire nails, cut nails and wrought nails. *Wire Nails.* Wire nails are cut, headed, pointed, and roughened (to increase their holding capacity) by machinery, from lengths of steel wire. *Cut Nails.* The cut nail is stamped from a sheet of metal coinciding in thickness with the width, and in breadth with the length of the nail. This nail tapers from a thin point to a fairly thick head, and should be driven so that the width of the wedge runs parallel with the grain of the wood instead of across, otherwise it is apt to split the wood. *Wrought Nails.* Wrought nails are manufactured from hot steel and will bend without breaking. Another classification of nails is according to the shape of the head. Flat-headed nails are used for ordinary work, where it matters not if the heads remain visible, while brads or finishing nails are employed when it is necessary to sink the heads below or level with the surface of the wood.

"Tenpenny Nails." There is a curious survival of an older nomenclature in designating the sizes of cut nails, though to some extent it has fallen into disuse. We occasionally hear of the "tenpenny nail," though we are not always aware that it is a 3-inch nail. A twopenny is 1 inch long, a threepenny $1\frac{1}{4}$ inches, a fourpenny $1\frac{1}{2}$, a fivepenny $1\frac{3}{4}$, and so on until we reach the tenpenny, but strange to say, a twelvepenny nail is $3\frac{1}{4}$ inches, a sixteenpenny $3\frac{1}{2}$ inches, and a twentypenny 4 inches long. It is conjectured by some that the tenpenny nails cost tenpence per hundred, while another explanation is that a thousand such nails weighed a pound.

Tacks. Tacks are of various kinds, as gimp, round-headed, flat-headed, and double-pointed, like a small staple. They are classified according to the number of ounces of iron required for a thousand tacks, as two-ounce $\frac{1}{4}$ inch, three-ounce $\frac{3}{8}$ of an inch, four-ounce $\frac{7}{16}$ of an inch, six-ounce $\frac{1}{2}$ an inch, and so on.

Screws. Screws are made of steel or brass, and are round-headed, flat-headed, square-headed, etc. The screw tapers from a fine point, where the thread begins, to a wider part where it stops, usually about two thirds of its

length, after which it is smooth and cylindrical for the remaining third. A longer thread would only weaken the screw. Screws hold more firmly than nails, yet they are more easily withdrawn when the need arises. Clamps, corner-pieces, dowels, and other forms of joining might also be dealt with. Small boxes and caskets should be constructed in order that the children may thoroughly grasp the principles of joining. A book rack, as in Fig. 26, forms a good exercise; also a trellis made of strips of wood fastened with tacks as in Fig. 26.

Turning.

Turning is another form of woodwork which should be examined, though there are few schools where it can actually be undertaken. The principles upon which the wood is turned in the lathe can be discovered, and some rods obtained from which a stool, as in Fig. 26, combined with a seat of raffia, and a swing, as in Fig. 26, may be constructed. The rods can be pointed and inserted into holes bored in the other rods to which they are to be joined, with a little glue to hold them firm. The exercises suggested are but a few of the many which will occur to the teacher as these lessons proceed. They are offered simply as indications of the lines to be followed, rather than as a full scheme of instruction.

History of Furniture

Having made a few enquiries into the manufacture of furniture, and the materials employed, the class might be led to consider its history, as the evolution of the human race is written upon the articles made for everyday use more surely and completely than upon the pages which record merely the doings of kings, and warriors, and statesmen. Man evolves slowly and steadily, each day, whether eventful or otherwise, contributing its quota, and the things he invents and makes exercise a greater and farther-reaching influence upon his development than do those cataclysms and social upheavals which are given precedence in history, as commonly understood.

Who first invented chairs, tables, couches, etc., it would be impossible to say. Probably prehistoric man used the skins of animals for couches and also for hanging at the entrance to his habitation to serve as a door.

The working of wood presumes the possession of tools, and those which remain from the earliest days are of a very primitive type. Hence the furniture which was made prior to Egyptian times is a matter for conjecture only. Fortunately the climatic conditions, and the customs of the people, of Egypt have preserved for us many things from which we can reconstruct its history. In the British Museum are chairs, couches, stools, etc., sometimes made of ebony and other rich woods, inlaid with ivory and covered with fine materials. Plate 28 illustrates some of the furniture made by the dwellers in the Nile valley. The bedsteads were sometimes made of a wicker of palm branches, though there seems to have been but little difference between the bed and the couch, which was probably used as a couch by day and a bed by night. The tables closely resemble those in use to-day. The dining-table was often circular with a central pillar support, sometimes carved in the form of a male captive. Tables of metal and stone as well as wood have also been found amongst the remains excavated from the tombs by the Nile. The chairs, too, are not unlike those in use to-day, as may be seen from those illustrated.

Egypt.

Greek.

The Greeks would seem to have used wood for some of their furniture, though they used other materials, as gold, silver, ivory, amber and other costly substances. From their pottery paintings, and relief carvings, we can gather some idea of their work, which was certainly very graceful. In Homer we read of tables of variegated wood, finely polished, and having ornamental feet. They imported curious woods from other countries, which was wrought into tables, which stood sometimes upon four legs, sometimes upon three, and sometimes upon a central pillar of silver, ivory, or other costly material. Occasionally they were inlaid with silver.

The bed of Odysseus, we are told, was of olive wood, inlaid with gold, silver, and ivory, but generally they were of common wood, such as deal, with planks or ox-hide thongs stretched across the framework. In later times solid silver, ivory, or precious wood, with feet of amber or carved ivory were used for bedsteads. From Persia and the East they acquired the taste for beds veneered with tortoiseshell, inlaid with gold. The poorer people slept upon skins or beds of dried herbs stretched upon the floor. The chairs used by the Greeks (Plate 28), were elegant and graceful. In the Homeric age they were richly carved, adorned with studs of silver, and so high that a footstool was needed. *Odysseus.*

The Romans seem to have had two marked epochs in their history. The first in which they were engaged in subduing the then known world (a period of hardihood), and the second in which they were degenerating into indolent luxury. In the later stage they reclined at their meals, a fashion they adopted from the Orientals whom they had conquered. Their dining-room they termed Triclinium, though it actually means three couches, or three beds. These couches were arranged on three sides of a square with the table making the fourth. The guests, usually three to each couch, rested upon the left elbow, leaving the right arm free. *Romans.*

Plate 28 shows a Roman chair which varies considerably from the more graceful Greek. A couch is also shown which does not differ greatly from a modern one. The Chinese also use chairs, being one of the very few Asiatic peoples who do. The Japanese usually sit upon the floor, except where they have adopted European customs.

There are very few actual remains of early furniture in England. We gather most of our information from ancient manuscripts and their illuminations. The richest Anglo-Saxon houses sometimes had the walls hung with embroidered silk. Chairs bore some resemblance to the modern camp stool, a low seat held in tension by two or more cross bars, though chairs with backs were *Early English.*

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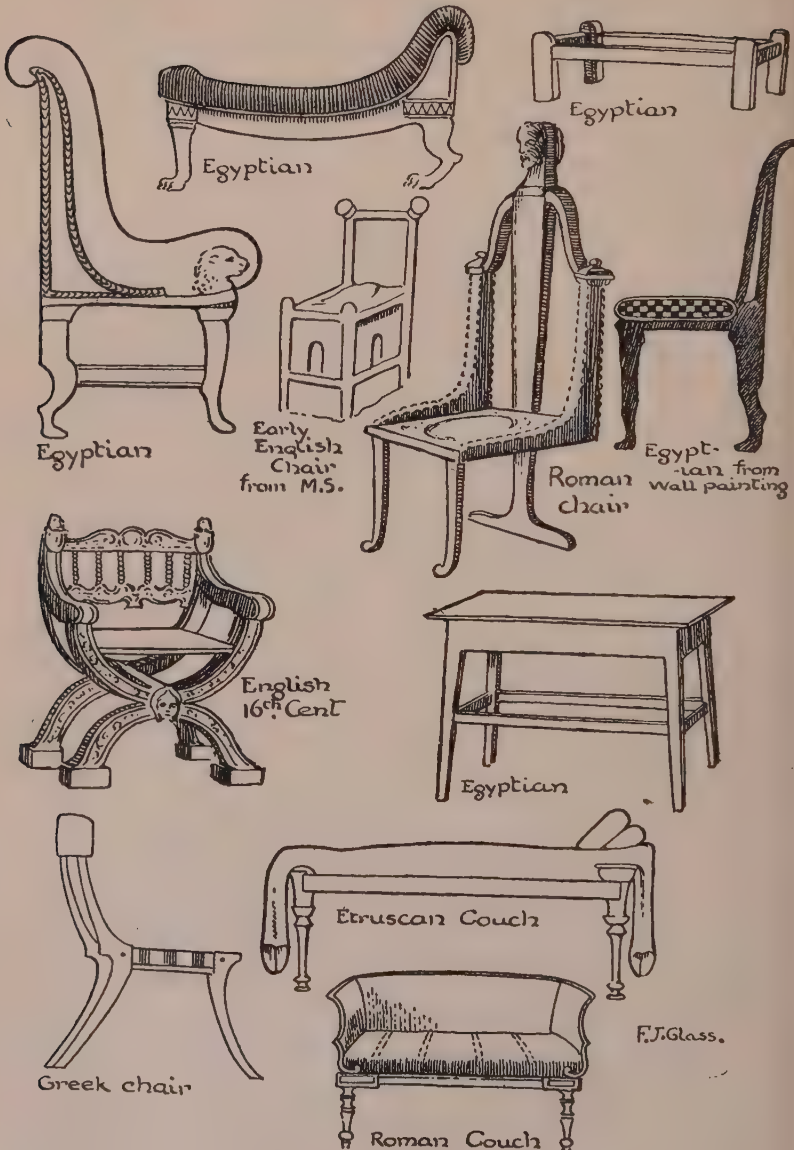

Egyptian
Egyptian
Egyptian
Early English Chair from M.S.
Roman chair
Egypt-ian from wall painting
English 16th Cent
Egyptian
Greek chair
Etruscan Couch
Roman Couch
F.J.Glass.

PLATE 28.

also used—Plate 28. Tables were of wood, though some early MSS. contain allusions to gold and silver. Beds and bedsteads are also mentioned and illustrated in these early documents, one at least of which possesses curtains, and a pillow, and a roof resembling that of a house. Beds, straw pillows, bedclothes and sheets, are also mentioned in wills of the period, proving that these people were not altogether ignorant of such comforts. Skins of goats and other animals often served as bed coverings.

Normans.

The Normans used similar furniture, while they often painted the walls of their rooms, instead of using embroidered hangings, though the Bayeux tapestry is a wonderful example of their needlework, designed for this purpose. It gives us an authentic picture of the life of the period. An entry in the Close Rolls enables us to form an idea of the Royal bedchamber of King John, as the cost of taffety, fustian, silk or fine cotton, couches or beds for the king are given together with the workmanship thereon. As a rule, however, in England furniture must have been somewhat crude and primitive, for during the Norman period most of the tables were supported on trestles, the seats were mainly benches, with one or two heavy chairs for the most important personages. The floor was strewn with rushes.

In the thirteenth and fourteenth centuries the fashion of painting the walls instead of draping them extended considerably. The subjects were Biblical, or were drawn from romances, lays, ballads, legends, or fables. In the reign of Henry III stained-glass windows were sometimes used in domestic dwellings, and in the fourteenth century we read that they were made to open and shut.

Coronation Chair.

The Coronation Chair in Westminster Abbey is perhaps the finest example of the chairs of this period now in existence. Chiming clocks formed part of the furniture of a mansion as far back as the thirteenth century. Gold and silver were used for cups, bowls, ewers, dishes, spoons, salt-cellars, and other articles for table use.

In the fifteenth century embroidered hangings became

fashionable again on the walls. Carved chairs, stools, tables, buffets, desks and coffers of this period may be studied either from manuscripts or from actual examples.

Sixteenth Century.

In the sixteenth century, from the time of Henry VIII to Elizabeth, changes in the forms of furniture may be noted. Round tables with central pillars, finely-carved buffets, bedsteads, clocks, firedogs, fenders, chairs (Plate 28), and couches of many types still exist in such places as Goodrich Court, Leeds Castle, Lovely Hall, and Hampton Court, besides that which may be seen at South Kensington and other museums. Straight, high-backed arm-chairs, with seats and backs padded and covered with velvet, looking-glasses, carpets, etc., belong to this period.

Seventeenth Century. Jacobean.

In the seventeenth century the mansions of the rich became very luxurious. Hangings of velvet, broidered with gold and silver, curtains of damask lined with fustian, beds, bolsters, and pillows of Milan fustian filled with down, quilts, blankets, etc., are mentioned in an inventory of that time. Hangings of paper and leather adorned the walls, while in some mansions Flemish and Italian masters were employed to paint upon them. Gobelin tapestries became a feature during the latter part of this century. The floors were still often rush covered, though a material known as "oilcloth" was known in 1660. It is somewhat doubtful, however, whether this was used as a floor covering. The furniture of this period is known as Jacobean, 1603–1688. It was mostly of oak, though walnut was used during the latter part. In general character it is stout and heavy, with straight lines predominating. Stools and benches were more common than chairs, though these were finely carved.

William and Mary.

William and Mary, 1688–1702, is another style of furniture. Walnut was mostly employed. It is simpler and more refined than earlier work, though colour in the form of lacquer, marqueterie, painting, gilding, and textiles, was frequently used. Fig. 29 is a typical example of the turning employed during this period.

Queen Anne and early Georgian, 1702–1750, was characterized by the frequent use of the double curve, like a flattened S, known as the "Cyma." Walnut and mahogany were both utilized. Cabriole legs and lower chair backs were notable features. Fig. 30 is a table belonging to this style. We cannot forbear to mention Grinling Gibbons, whose wonderfully dexterous carvings adorn St. Paul's Cathedral as well as a number of mansions. His work is remarkable for its extraordinary fragility and delicacy. We can only marvel at the consummate skill which fashioned those dainty petals, stems, and leaves; those fragile feathers, and that finely wrought fruit and ornament. We are so astonished at the supreme skill of the craftsman that we almost forget to apply the canons of æsthetic judgment. We forgive him for exceeding the just and lawful limitations of wood, because of the superlative artistry of the cutting. Sometimes, however, the fact is forced home upon us when we see how the work has perished, and also when we learn that a carver is constantly at work in St. Paul's repairing the damaged carving. Then we realize that technical skill should not be allowed to override the legitimate limitations of material, and that it is better to keep within those limits than to strain them in our efforts to exhibit our prowess. Simplicity is finer than over-

Queen Anne.

Grinling Gibbons.

Fig. 29.

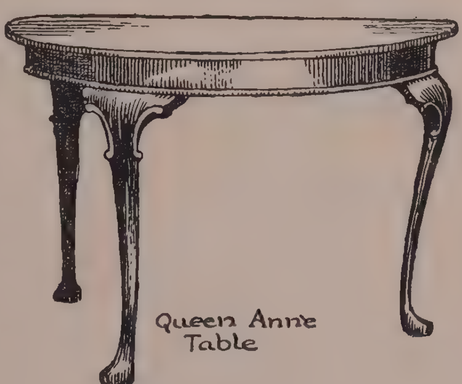


Fig. 30.

elaboration, and strangely enough is more difficult to achieve in art.

Louis XIVth. Louis XIV, 1642–1715, is marked by the severity of its structural lines, though the ornamentation is elaborate and profuse. Gilt, veneer, lacquer, metal, and tortoiseshell inlay, together with rich upholstery, adorn the furniture of this period.

Louis XVth. Louis XV, 1715–1744. Here curves replace the vertical and horizontal lines of the previous style; while elaborate carving, together with veneer, inlay, painting, and rich upholstery, were used to adorn it. This was the age *Rococo.* when "Rusticity" was a cult, and rococo ornament was evolved in the endeavour to express the ideas of the time. Wreaths, doves, cupids, and satyrs were much in vogue for ornamentation. It was a period of artificiality, when people with little real love for nature pretended to regard a life of rusticity with admiration, and this spirit of sham and counterfeit found expression in the work of the artist and craftsman as it inevitably must.

Chippendale. Chippendale, 1740–1780, brings us to the beginning of a fine period in furniture-making. Mahogany was mainly used, together with satinwood. His work is mostly characterized by strength and stability combined with grace and beauty. His first phase shows the influence of his English predecessors. The second is Gothic in type, with pointed arches, quatrefoils, pillars and fretted patterns. The third betrays the influence of Louis XV, with its shell and rococo decoration, and is the least satisfactory of his work. The fourth is Chinese in style and again falls short of earlier work, because it is somewhat of an affectation. Chinese pagodas are too foreign to the tastes of English people to be satisfactorily embodied in their art. The dictates of fashion tended to spoil the later work of Chippendale instead of allowing him to develop along his own individual lines. Art is always the expression of the spirit of the age and we can only regret the ephemeral fashion which led this fine craftsman to experiment in forms and methods which were alien to the inherent

tastes and thoughts of the nation to which he belonged. Fig. 31 is a chair belonging to his earlier period. He produced many designs of this type which are more valued than his rococo or Chinese work. He published a book of furniture designs in which he writes: "Upon the whole I have here given no design but what may be executed with Advantage by the Hands of a skilful Workman; though some of the Profession have been diligent enough to represent them (especially those after the Gothic and Chinese manner) as so many specious Drawings, impossible to be worked off by any Mechanic whatsoever. I will not scruple to attribute this to Malice, Ignorance and Inability, and I am confident that I can convince all . . . who will honour me with their Commands that every Design in the Book can be improved, both as to Beauty and Enrichment, in the Execution of them." Evidently he had enemies who were jealous of his ability, which is unfortunately only to be expected.

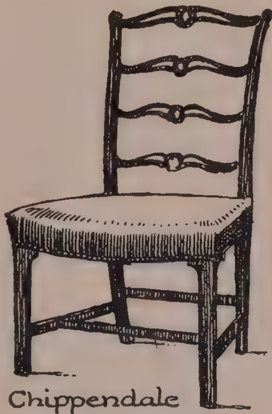


FIG. 31.

The Adam brothers, 1762–1795, produced some lovely work in mahogany, satinwood, and other lighter woods. Straight severe lines which are yet slender and graceful, characterize their furniture. Carving, turning, marqueterie, inlay, veneer, painting, gilding, and Wedgwood plaques were all employed, though with a Classic severity of treatment which rarely errs on the side of bad taste. Among the various ornaments employed by them were octagons, hexagons, ovals, rounds, lozenge-shaped panels, husks, fans, sphinx, Greek and Roman vases, wreaths, vases, medallions with figures—the medallions sometimes draped—festoons, fauns, cupids, goats, eagle-headed grotesques, drapery, ribbons, caryatides, mythological

Adam Brothers.

subjects, rams' heads, lions' and eagles' claws for feet, griffins, sea horses, pateræs, etc. Fig. 32 shows a chair and a bit of typical decoration of the Adam style.

Heppelwhite, 1765–1786, is again marked by grace, simplicity, and beauty. He used similar woods to those used by the Adam brothers. Fig. 33 shows a chair

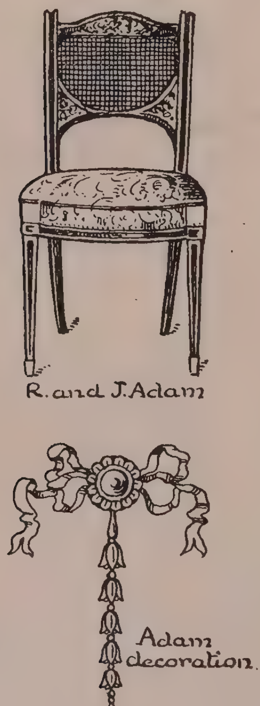


Fig. 32.

Fig. 33.

and a chair back, both characteristic examples of his work. He is perhaps best known by his designs for chairs.

Sheraton, 1760–1806, used mahogany and satinwood. Again straight lines, simplicity and severity are the dominant notes. He used inlay more than any mode of decoration, while the refinement of his detail and the dignity of his design are remarkable. Fig. 34 shows two

examples of his work. Sheraton also published a book of furniture designs, containing a number of excellent drawings, together with instructions for their execution.

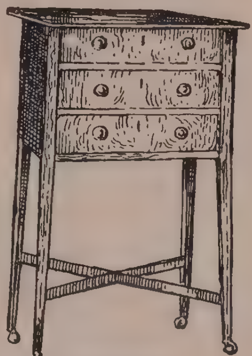
The last four furniture makers were responsible for an extraordinary improvement in their craft. Their work is much valued and innumerable copies are still being produced.

We cannot leave this period without mention of Angelica Kauffmann, Pergolesi, and Cipriani, who did a quantity of decorative work for the Adam brothers.

Louis XVI, 1744–1793, exhibits similar characteristics to those of Sheraton and Heppelwhite. The design is classic and severe.

Empire, 1793–1830, was of mahogany, elaborately decorated with brass. It was carved, turned, veneered, painted, gilded and finished with a high red polish.

Early-Victorian furniture is remarkable for its ostentation and solidity. It is weighty in construction, and heavily carved. The most elaborate curvature exists in legs, arms, backs, and other features. It suggests pomposity and self-satisfaction, which the horsehair coverings of chairs and sofas only serve to accentuate. William Morris, Walter Crane, and others, inveighed against the lack of honesty and simplicity displayed in the work of their day, and by producing furniture logically designed and constructed, did much to restore good taste in these things. They first considered the purpose of the article and the nature of the material to be employed in its production, and so constructed furniture which was beautiful because it was honest and useful.



Sheraton

Sheraton

FIG. 34.

William Morris.

William Morris is a man to whom we owe a great deal. He was earnest and forceful, and by dint of precept and practice he caused his contemporaries to recognize the beauty of well-made, simple things. It is impossible to estimate his influence upon present-day design and industry.

Of late we have reproductions of all styles and periods with no particular characteristics to mark this epoch from any other. There is perhaps more comfort in the modern home than ever there was before, but there is the risk of overcrowding the room, with a consequent loss of restfulness and simplicity.

It is a big subject, this of furniture. There is much in the schoolroom, forms, desks, chairs, cupboards, stools, etc., which might be examined and discussed with regard to purpose, make-up, materials, and finish. The difference between the surfaces obtained by wax polish, French polish, and varnish should be noted, and where possible the different methods experimented with. The articles made in the class might be treated with polish. French polishing is a decidedly difficult process, which requires considerable skill and practice, but there is no reason why some shellac dissolved in methylated spirit should not be obtained in order that the class might attempt it. They will certainly appreciate good work when they see it afterwards. Wax polishing is much easier, as either white wax or paraffin wax dissolved in turpentine, and rubbed briskly into the wood, will give a good polish. Varnish should be used with discrimination as it is apt to become very glossy and perhaps a trifle vulgar unless care is exercised.

Simple exercises in inlaying, wood staining, and even gesso might be attempted. These processes I have dealt with in *Drawing, Design, and Craftwork*, and there is no space here to deal adequately with them. There are, however, many exercises in woodwork and wood decoration which fall easily within the scope of most schools. These will occur to the teacher as soon as a start has been made along the lines here suggested.

CHAPTER IV

FABRICS

It would be interesting to know exactly when, and under what conditions, some prehistoric savage, a little more experimental, or inventive, than his fellows, first conceived the idea of twisting fibres together to form a longer one. But so remote is his day from ours, and so hazy is the record of his activities, that we shall probably never know. The race owes him a debt, however, even as it does his brother who first thought of interlacing these strands into a crude web or mat. "Necessity is the mother of invention," and doubtless the need for some sort of strand as binding or sewing material, led to the use of slender trailing vines, twigs, or grasses for these purposes, and also for trapping and fishing. The liability of these strands to break, and the disappointment caused thereby, led to the search for more suitable substances. Leaves, bark, stems, etc., in process of disintegration may easily have suggested the substitution of vegetable fibre, while the skins and tendons of animals killed in the chase would lead to the employment of thong and sinew. Vegetable fibres are limited in length, and until the idea of twisting them into continuous strands occurred to some inventive savage, their use must have been very restricted. The probability is, *Spinning.* however, that the idea did occur very early in history, for wherever remains of primitive man have been discovered, spun threads or spinning implements have been among them. Out of the spun thread grew in due course the art of weaving, because it supplied the loom with strands strong, flexible, and continuous.

The evolution of spinning through hand, hand spindle,

Implements. wheel, frame, and machine has vastly improved the quality and the quantity of yarn. In the spinning process a number of loose filaments are closely knit together into one homogeneous strand by means of twisting. This means that the filaments are extended and arranged in a somewhat parallel order, besides being brought into close contact in order to give them greater strength and coherence. To accomplish this, three separate processes are involved—attenuation, twisting, and winding. During attenuation the fibres are pulled out lengthwise, which brings them into a more parallel order, while twisting compresses them into a compact strand. Winding obviates the danger of tangling and untwisting, by bringing the yarn into a close, orderly, convenient fibre. Twisting has a tendency to weaken the individual fibre, but as the danger with yarn lies in the slipping of the fibres upon each other, rather than in the weakness of the fibres themselves, the process actually adds to the strength of the yarn.

Materials. The materials most commonly used are wool, silk, cotton, and flax. In order to learn something of the characteristic qualities of each, some fibres should be obtained both in the raw and in the manufactured state, *Testing.* compared, and subjected to simple tests. The manufactured material can be unravelled from scraps of fabrics. If the fibres are burned there is a noticeable difference in the results. The silk and wool will be found to leave a sort of crust, and to emit an odour similar to that of burning feathers, while the vegetable products, linen and cotton, leave charred ends. Some cotton bolls should be procured, and the children allowed to separate the fibre from the seed. This is a slow process when performed by hand, and prior to the invention of the cotton gin it took one person a whole day to clean a pound of cotton. The cotton gin works much more rapidly, and accomplishes as much in one day as the hand picker did in a year. Cases exhibiting the cotton in various progressive stages can be obtained, but where possible practical experiments should be carried out by

the class, as more is learned by doing things than by looking at them when done.

Linen. Linen is spun and woven from the fibres of the flax plant, which grows to a height of two or three feet, bearing blue flowers. *Flax.* The flax is pulled up by the root and subjected to the following processes: Rippling, which separates the seeds from the plant by means of "beaters" which loosen the seeds, and "shakers" which shake them from the flax straw. Retting or steeping rids the plant of its resinous matter, by soaking it in water and allowing it to ferment. This is usually done in a stream or dam, and the odour which pervades the district when the flax is withdrawn is unmistakable, it is so pungent and sickly. In the north of Ireland, where quantities of flax are grown, one is often assailed by this unpleasant odour, particularly during August. Grassing is the term applied to the drying process, after which the stems are passed between fluted rollers which break up the woody part, making it easy for the "scutcher" to separate it from the fibre. This fibre is made into bundles, and sent to the mill to be spun into yarn.

The next stage is the sorting or "heckling" which separates the longer, more useful portions called "line" from the shorter, ravelled part known as "tow." The heckler takes an oblong piece of wood, with strong steel teeth, about seven inches long, and a handful or "strick" of flax which he draws several times through the teeth of the "heckle." The flax is next formed into a continuous ribbon, called "sliver," by means of a spreading frame. The drawing frame then doubles the sliver, and draws it out by means of rollers through travelling gills with steel teeth. The attenuated fibre is taken by the roving frame which twists it slightly, then winds it on a bobbin. The "rovings" are now spun into yarn at a temperature of about 120° Fahrenheit, while wet. It is finally woven upon a hand or power loom into linen.

Silk. Silk is the most beautiful of textile materials, and is the product of the silkworm, though much artificial silk is made from wood fibre. Silk came to Europe from

China in the first place, and in the sixteenth century silkworms were cultivated in the lands adjoining the Mediterranean. The female moth lays her eggs (about 500) in August or September, and in the following May (when the mulberry leaves appear) these are hatched. The small caterpillar, emerging from the egg, feeds voraciously for a month or so, during which time it grows to about three inches in length. It then begins to sicken and to cast its skin, but in a day or so returns to its feeding. This happens four times, and occupies about a month altogether, after which the worm mounts a twig and commences to spin its cocoon.

This cocoon provides the material of which silk is made. Out of the spinnarets, two small openings in its head, emerge two slender filaments of the glutinous substance from whence comes the silk. These filaments adhere side by side, forming a flat thread, which the worm folds round its body, until it is completely enwrapped. If allowed to emerge of itself, the worm, after two or three weeks, would bore its way through the end of the cocoon, appearing as a feeble, ashy-white moth. In obedience to nature's law it then pairs off; and within a week eggs are laid, and the cycle of life is completed, with the commencement of another cycle. Only a small proportion, however, are allowed to emerge naturally, because in so doing the worm cuts through the silk fibres and spoils them. Consequently the majority are stifled in a heated oven, only as many being preserved as are necessary to produce the next crop.

The silk has now to be wound into hanks. In Europe, and also in some parts of the Orient, this is now done by machinery. Each operator has a basin of hot water, the temperature of which is regulated by a fire or a steam pipe, while overhead is a slowly revolving reel. The cocoons are placed in the basin, where the hot water softens the natural gum in the silk, allowing it to be wound off. The filaments (which are very fine) are passed through glass eyes, and crossed so that they become glued together into a thread known as "singles,"

which is then reeled into hanks called knots. The quantity of silk yielded by one cocoon is not very great, usually about 500 yards, though on rare occasions it reaches 1,000 yards. The remainder is too flossy or too entangled to permit of winding. From this part, however, spun silk is prepared. The better or thrown silk is cleaned, assorted, doubled to the required thickness and twisted in order to strengthen it, after which it is ready for weaving. Tussur silk comes from China and India, being the product of the tussur worm which feeds on oak leaves instead of mulberry.

Wool. Wool, as we all know, is sheared from the sheep. Interest can be stimulated by reading some of the numerous stories of sheep and shepherds, and by procuring reproductions of pictures representing them. The washing and shearing of the sheep is enquired into, and the part played by the shepherd's dog in tending and herding them to the desired spot will certainly appeal to the child. Pictures will help considerably in giving a clear idea of these things. It is not a bad plan to obtain some raw wool just as it comes from the sheep, and to experiment with it. Wash it with soap and warm water, thoroughly rinse it to remove grease and dirt, and allow it to dry. Some of it may now be dyed with fairly bright colours in order that they may appreciate the difference between the natural tint and the hues in which they are accustomed to see it. When dry it is carded so that the twisted, knotted fibres may be separated and formed into rolls or slivers.

Carding. The cards are two small boards with handles; a series of spikes project from the boards, and by drawing one across the other with the wool between, the fibres are pulled out and separated. The fibres are then twisted, sometimes between the fingers, and sometimes by rolling between the hand and thigh—see Plate 35. These are primitive methods, and have been replaced by machinery. In early days when the wool was carded by hand it was difficult to manipulate a lot of carded fibres without entangling them, and so they were wound

lightly around a stick called a distaff. Spinning the fibres between the fingers was also very laborious, and this led to the spindle.

Spinning. The method at first employed was for the spinner to fasten the distaff to her belt, or to hold it beneath her arm, and drawing out a few fibres, she would twist them and insert them in a cleft cut in the end of a wooden spindle. Then twirling the spindle she continued to pull out fibres, which were stretched and twisted into an even thread by the weight and action of the revolving spindle—Plate 35. Naturally there was always a danger that the thread would unwind when the spindle had slackened its whirling, so to obviate this it was given an extra whirl in the right direction, wound around the spindle and inserted in the cleft.

Then came the spinning wheel—Plate 35. This was a large wheel attached by a belt to a smaller wheel and spindle. The large wheel was revolved either by hand or by means of a treadle. The spinner again fastened her distaff to her belt, and pulling out some fibres she twisted them and inserted them in a cleft in the spindle. The wheel was set in motion, and the fibres supplied from the distaff to the spindle which twisted them into yarn. This yarn was wound on the spindle in order to keep it from tangling or untwisting. This process continued until the spindle was full of spun yarn. Such methods obtained for many years, until the invention of the steam engine made it possible to produce machines which completely revolutionized carding and spinning.

Carding. Carding is now done with a slowly revolving cylinder, and several swiftly turning smaller ones, working in the opposite direction. The cylinders are set with fine spikes and the fibres pass between those on the large cylinder and the others on the smaller ones. Spinning is also carried out at a much greater speed and with less labour.

John Hargreaves. John Hargreaves invented the spinning jenny somewhere about 1765, which could spin a dozen threads at

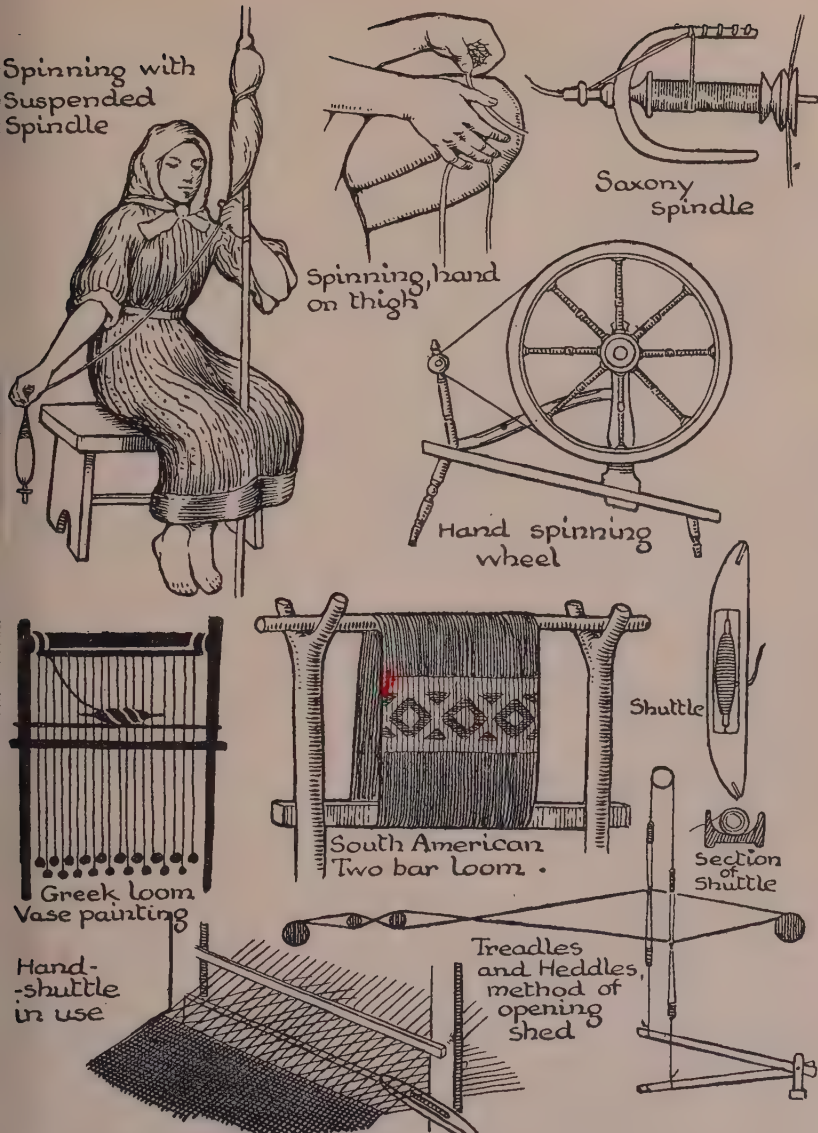

Spinning with Suspended Spindle
Spinning, hand on thigh
Saxony spindle
Hand spinning wheel
Greek loom Vase painting
South American Two bar loom.
Shuttle
Section of Shuttle
Hand--shuttle in use
Treadles and Heddles, method of opening shed

PLATE 35.

one time, but they were of a poor quality and only fit for use as the weft or filling threads in weaving.

Richard Arkwright. Richard Arkwright, in 1768, patented a water frame, or drawing frame, which produced very fine threads, by drawing the fibres out with two sets of rolls, running at different speeds.

Samuel Crompton. The mule spinning frame, made by Samuel Crompton, followed in 1779, combining the better parts of the two previous inventions. In 1830 came the modern self-acting mule, which brought this branch of textile work into line with carding and weaving.

Having spun the fibres into thread uniform in thickness and continuous in length, the next process is to weave it into fabric. There are many kinds of textile fabrics and a collection of these should be made and the charac-*Fabrics.* teristic qualities examined and discussed. There is silk, satin, brocade, linen, damask, printed cotton, twill, muslin, serge, tweed, to mention a few; while there is also tapestry, carpets, canvas, etc. Some have patterns printed upon them, while others are woven into patterns.

Weaving. The principle of weaving is quite a simple one, consisting of the interlacing or interweaving of two sets of strands or threads. A loom is necessary, and one set of threads called the "warp," is arranged lengthwise on the loom. The opposite set of threads known as the "weft," is interlaced with these, each strand passing alternately under and over the threads in the warp. The loom is consequently designed to perform three separate movements. It parts the warp threads to form a shed, some strands being lifted while others are depressed; it passes the shuttle between these threads, leaving a strand of weft in its passage, and finally it compresses the growing fabric into a close, compact web. The alternate threads are raised and lowered by means of a harness frame which enables the weft to pass over certain threads and under others at a single throw of the shuttle from side to side. In early looms there was no harness frame, and the operation of interlacing the weft under and over the warp was a long and

tedious one. Nowadays power looms turn out woven fabrics, often with very complex patterns, at a great speed.

History

Weaving is one of the earliest and most universal of the industrial arts. Egypt, China, and India produced excellent fabrics at a very early date, while practically every race has produced woven materials of some kind. It is interesting to compare the methods employed by different peoples, and to note the similarity in these methods, and in the implements used by them. The difference between the primitive looms used by the first weavers, and the elaborate power looms now in use, is a matter of development rather than of actual change, for the principle is the same throughout. The evolution of weaving methods is typical of the progress of industrial methods generally. Pictures of looms should be collected and discussed with a view to discovering their actions and capabilities, and the accumulation of improved devices which has resulted in the modern loom. Plate 35 illustrates an early Greek loom, and a South American loom of primitive type. *Weaving.* *Greek Loom.*

Some of the improvements which have led to the modern loom are the flying shuttle invented by John Kay in 1773, the cotton gin by Eli Whitney in 1793, the spinning jenny (already mentioned), the power loom of Edmund Cartwright in 1785, the pattern-weaving loom of Jacquard in 1804, and the Lyall loom in 1872. *John Kay.* *Jacquard.*

Exercises

The children should now be encouraged to try their hands at weaving, in order that they may retain a clearer conception of the process. Raffia has much to recommend it, in teaching the principles of winding, plaiting, and weaving. Raffia fibre, as we know it, is obtained from a palm which grows in the warmer parts of Madagascar. It is prepared from the fibrous under-surface *Raffia*

of the young fronds, which is peeled from the upper useless portion, dried, and split into useful widths. The natives use it in the manufacture of cloth, sometimes in combination with a warp of silk. Cloth for mats, garments, and curtains are woven by them on their primitive looms. They dye the raffia and the patterns produced with the coloured fibres are often very charming.

It is interesting to note the variety they manage to get into their patterns, often the difference between two patterns will be very slight, but it is sufficient to give interest to the work. Herein lies the charm of hand work as compared with that of the machine. Once the patterns have been set up on the machine and the mechanism started, it is cheaper and less trouble to produce a large number than to do a few. When woven by hand it is easy to introduce new forms and new combinations of forms and colours, and it is far more interesting to do so than to keep on repeating. Photographs of natives at work on their simple looms can be obtained, and should be used as class illustrations, and also compared with pictures of the complicated power looms.

Hand and Machine.

Raffia is cheap, easy to handle; can be fashioned into quite a number of useful articles, and good colours are obtainable, or it can be dyed in the school. Plaiting the strands of raffia together forms a good basis for the manufacture of mats, bags, and other articles. Groups of three, four, five, or six strands may be plaited together as shown in Plates 36, 37.

Plaiting.

The three-strand plait is the simplest and most common form, and should therefore be first practised. The principle is exactly similar in the four-, five-, or six-strand plait. For the first attempt three single strands of differing colours, say one purple, one blue, and one green, should be employed, as it makes it much easier to see the positions of the strands in the finished plait. As the strands of raffia are somewhat restricted in length it becomes necessary if a continuous length is needed to

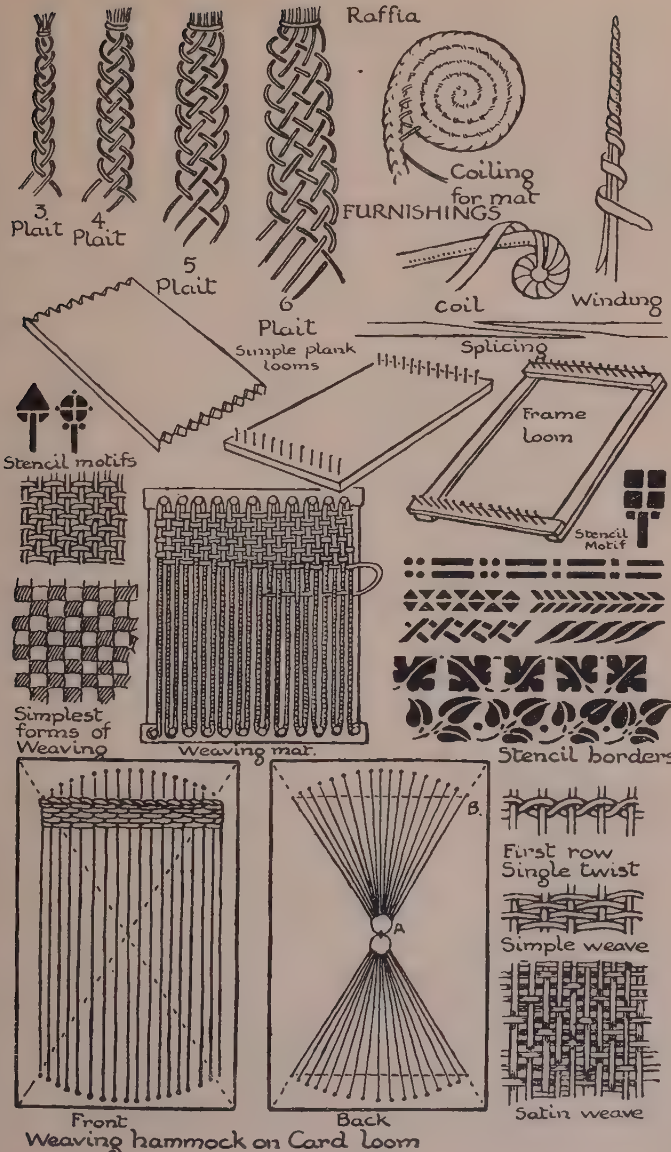

Raffia
3 Plait
4 Plait
5 Plait
6 Plait
Coiling for mat
FURNISHINGS
Coil
Winding
Splicing
Simple plank looms
Frame loom
Stencil motifs
Stencil Motif
Simplest forms of Weaving
Weaving mat.
Stencil borders
B.
A
First row Single twist
Simple weave
Satin weave
Front
Back
Weaving hammock on Card loom

PLATE 36.

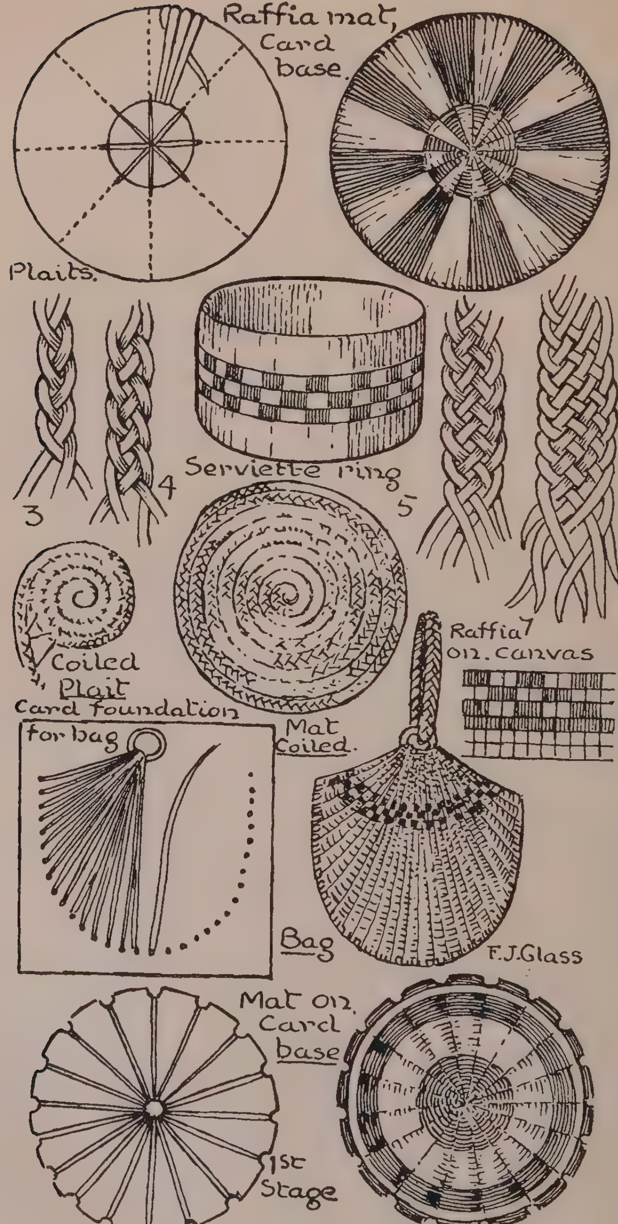

Raffia mat, Card base.
Plaits.
Serviette ring
3
4
5
7
Coiled Plait
Card foundation for bag
Mat Coiled.
Raffia on canvas
Bag
F.J.Glass
Mat on Card base
1st Stage

PLATE 37.

plait a fresh strand in as the previous one nears its end. The ends of both strands are plaited together for a short distance, and if anything is left over it must be trimmed close when the work is finished. Pressing with a hot iron will improve the appearance of the plait.

A mat may easily be fashioned by coiling and sewing a length of plait as indicated in Plates 36, 37. A three-plait composed of nine strands of raffia is good for this purpose, as it gives a suitable thickness to the mat. Fig. 38 shows a raffia mat on a cardboard base; the strands are interlaced with others which radiate from

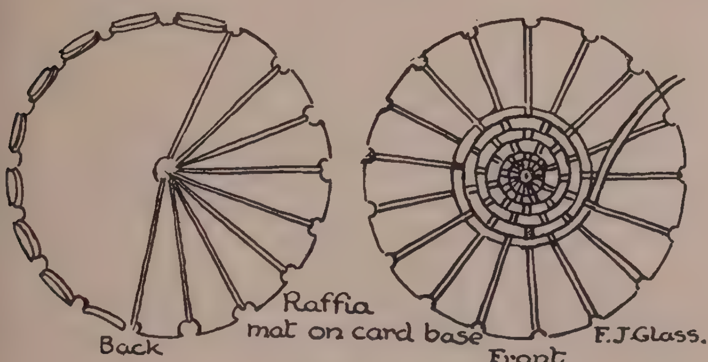


FIG. 38.

the centre to the outside of the disc where slots are cut to hold them in position. These form the warp as it were, while the weft is interlaced, spirally, commencing at the centre and working towards the outer rim of the card. Many articles can be made of raffia, as napkin rings, bags, tea cosies, hats, etc., while combined with cane and basketry the scope is wider still. *Articles of Raffia.*

Another valuable exercise for giving the children an insight into weaving methods is the manufacture of a doll's hammock on a card loom. The purpose of the hammock, strength required, and materials to be used are first discussed and settled, after which the size is decided upon and a suitable card procured. Find the *Hammock.*

centre of this card by drawing diagonals, and describe two arcs from this centre with length A B as radius—Plate 36. Punch a series of holes on these arcs, and through the corresponding holes at either end of the card thread some lengths of twine. Two curtain rings are tied together and fastened to the centre at the back of the card loom. Each strand, after passing along the front of the card from end to end, and then through holes to the back, is here knotted to the curtain rings. When all the strands are fastened in position the weaving begins. The hammock is strengthened considerably if the first row, at either end, is arranged as a single twist (illustrated), after which the strand is taken under and over in the usual manner. When the weaving is complete the card is cut away, and the hammock is ready for suspension by its two rings.

Looms. Having learned something of the process upon a card loom the next attempt might well be made upon one of wood. Some methods of preparing these for use are shown in Plate 36, Plate 39, Plate 40, but it matters not a scrap what type of loom is employed, so long as the principles involved are rendered clear and easy to grasp. Mats of wool for the doll's house would form a useful exercise, worked upon one of these simple looms.

Decoration. The decoration of textiles is worthy of attention, and the patterns which result most readily from the process of interlacing should be carefully noted. First, and most obvious of these is, of course, the chequer pattern (Plate 36), which inevitably results from the interweaving of two sets of strands, each differing in colour from the other set. Strips of coloured paper might usefully demonstrate this. The difference between woven and printed decoration should be examined and discussed. It is better if the æsthetic element is borne in mind during all these lessons. The patterns themselves should be judged with due regard for their suitability for material and purpose, for the type of *motif* employed, and the manner in which it is used, while the colour scheme is

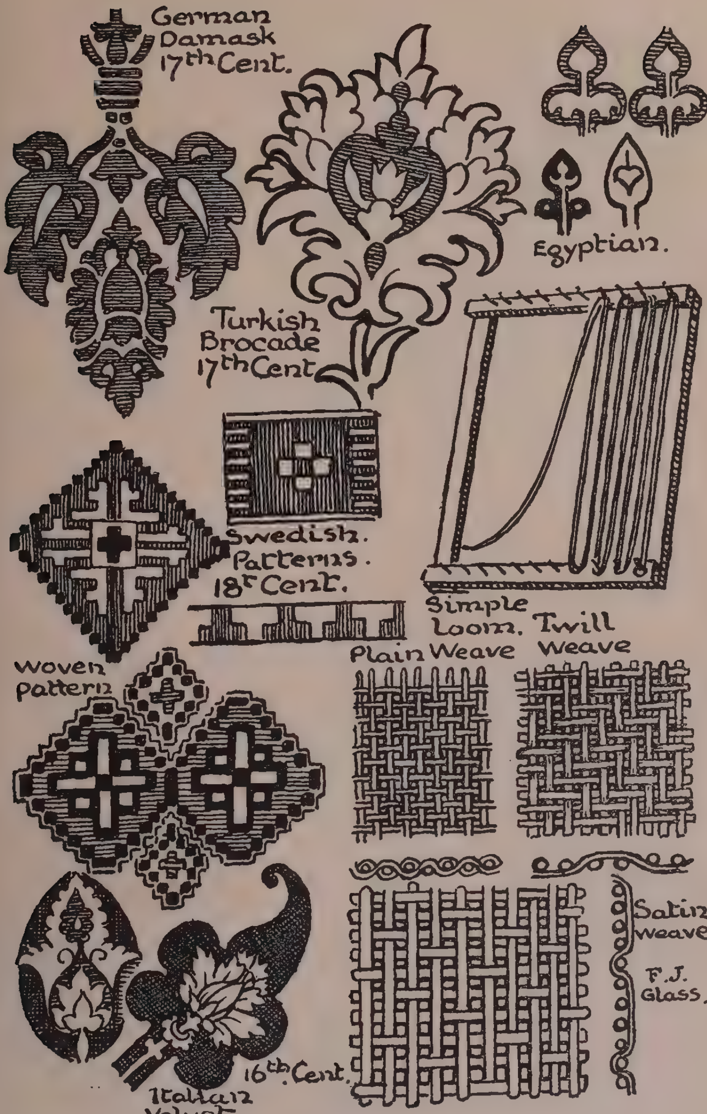

German
Damask
17th Cent.
Egyptian.
Turkish
Brocade
17th Cent.
Swedish.
Patterns.
18th Cent.
Simple
Loom.
Twill
Weave
Plain Weave
Woven
pattern
Satin
weave
F. J.
Glass.
16th. Cent.
Italian
Velvet.

PLATE. 39.

very carefully considered. The aim is to encourage the children to appreciate the best, the most tasteful and suitable things in each of the industrial arts dealt with in the class.

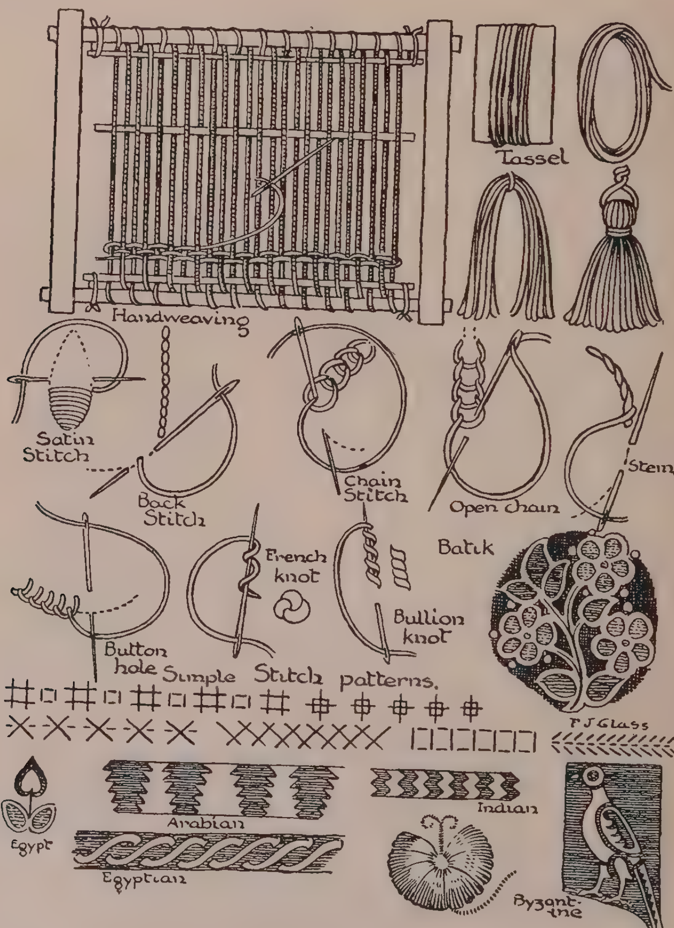


Plate 40.

The simplest form of weaving gives us the chequer pattern, if warp and weft differ in colour. Other patterns result from more intricate systems of weaving. In our illustrations, Plate 36 and Plate 39, two other common

methods are drawn in addition to the simple weave. These are known as the twill and the satin weave. The twill weave passes over, and under, two threads instead of one only, as in the simple weave. The satin weft is taken over one and under four strands of warp, and it is easily seen that these systems of weaving will result in patterns different from that given by the simple weave. In the Jacquard loom the most elaborate and intricate designs are woven with the aid of perforated cards. *Twill and Satin Weave.*

In order to give the class an insight into printing methods, a linoleum block may be cut and printed upon a curtain, cushion cover, scarf, or other textile calculated to be of use or interest to the child. Some simple *motif* should be chosen with a view to its repetition, and to the purpose for which it is to be employed. It is better to design this on paper first and to transfer it to a suitable piece of lino, though it is quite easy to draw a simple unit of repeat directly upon the linoleum. The parts which are not required for printing are then cut away with a knife and a couple of gouges. The raised surfaces which remain standing are painted over with dye or pigment of some description and impressed upon the material. It is safer to rub the back of the material, while still resting upon the lino block, with the bowl of a spoon, or a smooth knife handle, or other suitable article, if a clear sharp impression is desired. *Lino-leum Printing.*

Stencilling is another form of decoration which lends itself readily to fabrics. Here the pattern is cut from a sheet of oiled paper, with due regard for the process which demands that the stencil plate shall be well knit together by means of "ties," and colour is dabbed through the interstices in the plate with a stiff short-haired brush. Dyes, oil colour, or water colour can be employed if used fairly dry, as when too much moisture is present the colour is apt to spread, ruining the shapes in the pattern—Plate 36, Fig. 41. *Stencil-ling.*

Batik is another charming form of ornamentation which is being revived, and which can easily be undertaken in the class. Special outfits can be obtained from *Batik.*

dealers in artists' materials, though it is quite possible to prepare one's own materials. The most suitable fabric for this purpose is a soft white silk or crêpe de Chine. The pattern prepared with due regard for the method to be employed, and the purpose the fabric is intended to serve, is painted upon the fabric with molten wax, which is kept liquid in a metal vessel over a gentle flame. White paraffin wax is the best for the purpose. When the design has been drawn in the molten wax, using a sable brush for its application, the dyes are added, and again sable brushes are the best, though camel hair or hog hair which have been used sufficiently to become soft, will serve quite well.

Fig. 41.

Wax.

If the pattern is intended to be in polychrome, the different dyes are painted into the areas they are to occupy. If the pattern is a comparatively small one, upon an expanse of ground, it is advisable to dip the

fabric into a bowl containing the dye which is to form the ground colour. Before doing this, however, the colours already applied must be protected with a coating of wax. Before placing the fabric in the dye, it is dipped in cold water to thoroughly harden the wax. Should a crazed or crackled effect be desired the material is squeezed and crumpled between the hands to crack the film of wax. When plunged into the dye it will percolate into these cracks, and produce a series of fine hair-like lines, which adds greatly to the charm of some patterns. *Dyeing.*

When the dyeing is completed the fabric is allowed to dry, after which it is laid between sheets of paper and ironed with a hot flat-iron until all the wax has been extracted. The heat of the iron melts the wax and causes it to soak into the paper, which must be changed three or four times until all the superfluous wax has been extracted from the material. This is a very charming method of decoration eminently suited to fabrics. The patterns should be fairly simple, relying upon well-shaped patches of pleasing colour rather than upon intricacy of design—Plate 40, Fig. 41. *Removing Wax.*

For printing purposes a potato is quite useful. The potato is cut cleanly so as to leave a flat surface, and some simple *motif* carved upon the surface so obtained. If the patterned surface is pressed upon a pad of flannel or blotting paper, generously smeared with colour, and again impressed upon the material, the pattern will be printed in colour. This is the basic principle of all printing processes, no matter how elaborate may be the machinery employed.

Stitching or embroidery is another mode of decoration, and the children, after learning how to make various stitches, should be encouraged to combine them into patterns. Some of the possibilities that lie in this direction are indicated in the drawings—Plate 40, Fig. 41. Stitchery is a logical form of decoration as it combines utility and ornament. The stitches which hold the various parts together can be so applied as to add to the *Stitchery.*

beauty of the work. They can be turned into decoration while performing a necessary duty. There are quite a number of stitches in addition to those sketched, but the teacher can decide which are the most useful, and the best suited for the purpose in hand. Girls should certainly learn something of decorative stitches, not only that they may use them for their own work, but also to give them an appreciative and a discriminative taste wherewith to regard the work of others.

Lace. Lace should be considered and examples of the various kinds collected, examined, discussed, and tabulated. Pillow lace, point lace, Honiton, and the various kinds produced in different places, and the methods employed in their production, will furnish material for thought and discussion. At one time most of the lace produced was made by hand, but with the growth and development of machinery, more and more of it is executed by mechanical means.

In the production of pillow lace, of which there are several kinds, as Brussels, Mechlin, Valenciennes, Lisle, and Alençon, a pillow is employed as the name suggests. Upon the pillow a stiff piece of parchment or other suitable material is placed, and pins are inserted in conformity with the design to be formed. The threads of which the lace is to be made are wound upon small bobbins, from which the threads are twisted around the pins and around each other in various ways in order to form the meshes which constitute the network upon which the pattern is built. The characteristic feature, however, is the interlacing thread which, winding through the meshes, helps to produce the pattern. This thread is considerably stouter than the ground meshes.

The invention of the " bobbin net " machine by John Heathcoat in 1809 made it possible to imitate pillow lace by machinery. Later machines actually embroider the pattern upon the net at the same time as the net is made. Nottingham is the centre of the lace-making industry.

Calico printing. Calico printing is worthy of notice, for there is a large quantity of printed calico upon the market. The decoration of calico was practised in India long before it was attempted in this country. The process employed by the natives was an elaborate one. The fabric after leaving the loom was first worn for a period, after which it was steeped, beaten, washed, and dried in the sun. It was then soaked in a liquid formed of curdled buffalo milk and the juice of an astringent fruit. When thoroughly impregnated it was taken out of the liquid and dried in the sun, after which it was rubbed and pressed.

Mordant. The next stage was the preparation of the design, which was first drawn upon the calico, and then the various forms painted with a mordant. The mordant for black was acetate of iron mixed with palm wine, for red it was alum water, coloured with sappan wood and thickened with gum, and so on. The cloth was then exposed to the sunshine to dry, when it was again soaked in water to remove such parts of the mordant as were unnecessary. A vat of dye formed by boiling certain roots in water was prepared and the fabric boiled therein for a considerable time. The parts which had been treated with the iron mordant became black, the alum mordant turned the portions treated therewith red, while the remainder, after washing and bleaching in the sun, turned white. Pliny tells us that the ancient Egyptians used a similar method for dyeing fabrics, and he expresses his wonder "that although the dyeing liquor is only of one colour, the garment is dyed by it of several colours."

There are various methods employed for printing calico in England. There are block printing, press printing, cylinder printing, and bandana printing. Block printing will be readily understood by the children after they have cut and printed a linoleum, or a wood block. This method is largely a hand-printing one, and has to a great extent been superseded by mechanical processes. A large proportion of the work is done by means of engraved cylinders. These cylinders, bearing the pattern,

revolve in a trough containing colour, the superfluous pigment is scraped off by means of a smooth knife, while the remainder is transferred to the cloth, which passes over the roller in continuous lengths.

Bandana Handkerchiefs. Bandana handkerchiefs are produced in a different manner. The cloth is dyed uniformly, and then arranged in layers upon the bed of a press. The bed is then forced against a horizontal frame above, in which holes are drilled. Liquid chlorine is passed through the holes, penetrating the material below, removing the colour as it descends, leaving spots which correspond with those in the upper plate.

Carpets. Carpets will furnish an interesting topic for discussion. The difference between Oriental and home-produced carpets; the characteristic features of Persian, Indian, Turkish, etc., as compared with Kidderminster, Wilton, Brussels, Axminster, and other home-woven fabrics, should be noted. Axminster carpets are usually made in one piece according to the shape and size of the room they are intended for. The warp or long threads are of strong linen. Small tufts or bunches of different coloured worsteds are fastened to the warp threads and when a row of tufts is completed a weft thread of linen is thrown across with a shuttle. The next row is worked in a similar manner, the colours being so arranged as to form the desired pattern. This pattern or design drawn upon paper is within view of the weaver as he works. Needless to say, the warp and weft of linen threads are completely hidden by the worsted tufts in the finished carpet.

Brussels. Brussels carpet is also composed of a warp and weft of linen threads with a series of loops of worsted interwoven. It has two tiers or layers of weft threads with the worsted introduced between, and bound up by them.

Floor-cloth. Floorcloth is made of a strong cloth woven of flax, coated with paint, though nowadays cork lino and other thicker and more substantial floor coverings have practically replaced it for this purpose.

Parquetry, or wood mosaic, is another form of flooring, while waxed and polished woods can be very charming, especially if a few well-chosen rugs are laid upon them. *Parquetry.*

Tiles are also useful for floors, especially where frequent washing is desirable, while mosaic or tessellated floors have been in vogue since the days of the Romans. In many public buildings examples of mosaic floors may be seen, and also in churches. In Westminster Cathedral there are many excellent examples of mosaic and of marble inlays to be seen in the adornment of the various chapels or niches which flank the broad central nave. Mosaic was extensively employed in the decoration of Byzantine basilicas, where its charming colour added glow and lustre to interiors which otherwise would appear bare and austere.

Fig. 41 shows some stencil patterns of Japanese origin which give an idea of how skilful they are in designing these patterns. The contrast of light and dark flowers and the skilful use of spots is well worthy of note. Plate 39 gives a few designs culled from various sources showing an interesting branch of study which may well be introduced into the class. They might be allowed to draw some of these patterns in order that they may learn the type of design which results naturally from the methods employed. Squared paper is useful for working out textile designs. *Stencils.*

Fig. 42 gives an idea of another useful exercise which might arise out of the consideration of garments. Collars, cuffs, and a simple dress for a doll could be designed and made, as indicated in the diagrams. *Garments for Doll.*

Clothes

Dress in itself is an interesting subject with many ramifications. It might easily arise out of the garments worn by the children themselves, the materials employed, the colours chosen, and the difference in form according to sex. Taste and discrimination in these matters might be inculcated by diplomatic talks. The difference between *Dress.*

harsh, clashing colours and harmonious ones; the choice of garments according to height, build, etc., might be discussed.

History of Dress. Then there is the history and significance of clothes, ranging from the skins and furs of primitive people, through the loin cloths of savage peoples, the robes and togas of Greece and Rome, the elaborate armour and trappings of knights, nobles and kings, to the garb of modern days. Some of these are very picturesque, some

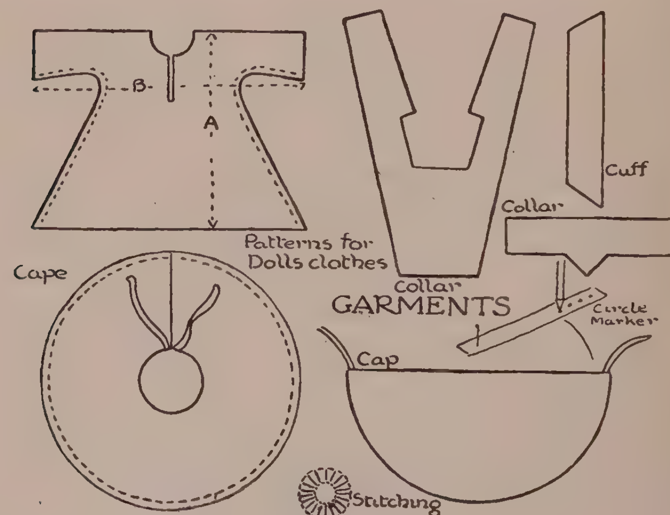


FIG. 42.

are decidedly ugly, but each bears the stamp of the age and the peoples who designed and wore them. The study of history is incomplete without some consideration of costume. Every picture of historic events must be correct in the delineation of the garments worn by the figures, or it is false historically. Pictures of the garments worn at different periods by different peoples can easily be obtained, and should be examined and discussed in the class.

Significance of Clothes. The significance of clothes is another fascinating branch of this subject. To a large extent we estimate

people by their garments. As Carlyle cynically suggested, without them we all bear a close resemblance to forked radishes, and certainly there is very little in the unclad human figure to indicate social distinctions. Clothes serve to separate society into various strata, and are used to distinguish one grade from another. There are of course more subtle qualities, as speech and manners, which differentiate one grade from another, but these are less obvious. If we would honour a person we deck him in special robes and regalia. Our kings look more regal when decked in all the panoply of state. Nobles might be mistaken for ordinary folk if seen in ordinary garb, or even minus. We add to the awe-inspiring appearance of judges by adding wigs and flowing robes to their outfit. Our naval and military leaders are impressively garbed in order that they may be treated with due respect. Mayors, aldermen and councillors are distinguished from common townfolk by their civic robes. Soldiers, sailors, policemen and postmen are obviously government servants, when in uniform. It is the uniform of the police which scares the small boy, for in ordinary clothes he is by no means awe-inspiring. Then learning has its academic robes, sometimes conferred upon the unlearned it is true, but as a rule carrying with them an atmosphere of scholarship. Sport carries with it a number of special costumes. Plus-fours for golf, white flannels for tennis and cricket, jerseys and shorts for football, tight-fitting costumes for bathing, and so on. There is also the top-hat and frock-coat for important functions, the evening dress, dinner jacket, etc. Fancy dress, and costumes for plays, is still another aspect which will appeal to the child, for the normal child loves to "dress up," but enough has been said to indicate some of the possibilities which lie in this fascinating subject of textiles and costumes.

The question of washing, ironing and preparing clothes is another branch which might usefully be dealt with, also the darning,patching and repairing of garments. Geography is introduced by a consideration of names of

fabrics and the places from whence they come. Calico, muslin, Chinese silk, Persian carpets, Irish linen, Harris tweed, and so on, suggest a visit to the places from whence they come. There is plenty of scope in this subject for many lessons of real value especially if combined with the craft lessons suggested.

CHAPTER V

LEATHER

LEATHER calls for consideration. Gloves, boots and shoes, handbags and other articles constantly seen or used by the children will serve as an introduction. Leather is the skin of an animal which has been cleaned and tanned. In order to give an idea of the preparation necessary, a rabbit- or mole-skin can be obtained and stretched upon a board. Any flesh or membrane which remains is scraped away, the skin well rubbed with salt and alum and allowed to dry. It is again scraped, and rubbed until quite soft. After this simple method of preserving, it may be used in making a coat for a doll, and a discussion started upon furs, boots, moccasins, leather garments, etc. The employment of furs as a protection against cold, and the frequent use of them in Arctic climates, in addition to their use as adornment, should be considered. *Skin of Animal.*

Feathers, too, as employed for adornment, and the slaughter of birds at the dictates of fashion and vanity might be considered. G. F. Watts's picture of the "Sorrowing Angel" mourning over the destruction of these feathered songsters, illustrates the opinion of a great artist upon such wanton cruelty. Reproductions of his picture can be obtained and exhibited before the class. The slaughter of animals is regarded as a necessity by all save vegetarians, consequently the use of their skins for fur and leather is hardly as senseless and wanton. The lonely life of the trapper, who in the solitudes of North America and other lands where man is rarely seen, spends long periods gathering skins, will furnish an interesting theme. *Trappers.*

Skins. The skins of animals consist of two principal layers, the inner corium or true skin, and the outer or epidermis, which is protected by hair. The first process after the hide has been removed from the animal is to scrape the flesh and tissue away from the inner side by means of a long knife—Fig. 43. The skin is placed in a large vat containing a solution of caustic lime, and kept moving until the hair is loosened by the dissolution of the epidermis cells. This takes from one to three weeks, according to the nature of the skin. Sometimes the hide is placed in a warm chamber, where the hairs become loose owing to an incipient putrifaction which ensues. The hair is then scraped away with a large two-handled knife while the skin is stretched over a convex beam or block—Fig. 44. Alkaline sulphides have to some extent replaced lime for the purpose of removing hair. When sufficiently clean the hide is steeped for some days in an acid solution which opens the pores and softens the hide in preparation for the tanning solution.

Tanning.

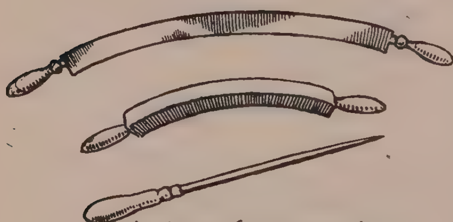


FIG. 43.

Tanning Solution. This solution is an astringent vegetable product known as tannin. The bark of the oak tree is perhaps the oldest and still remains one of the most satisfactory of tanning materials, though many others are also employed. Oak sawdust, oak leaves, and galls, pulverized heath, birch bark, myrtle leaves, willow bark, mangrove root, tormentil root, valonia, chestnut extracts, and hemlock are all employed for tanning purposes. An acid extracted from the bark is largely used nowadays. Whatever may be the solution it is poured into pits in readiness for the hides. These "butts" or hides, from which shoulders,

necks and the thinner parts of the belly have been "rounded" or cut away, are suspended in pits containing weak tanning solutions. They are not allowed to remain still but are moved frequently, and are advanced into stronger and stronger liquors until the tanning process is completed. For heavy hides the excrement of fowls and pigeons is sometimes used, while for finer leather that of dogs is employed.

Fig. 44.

Chemical preparations such as "erodin" are gradually replacing these materials, however, while alum and salt, or some "combination," or chrome tannage is sometimes employed. At one time two years was the period occupied by the tanning process for sole leather, and there are still tanners who take twelve months over the work, but from three to six months usually suffices nowadays. Sole leather is finished by stretching and smoothing with a two handled tool of triangular section called a "striking pin" and by rolling with brass rollers, after which it is dried in a gentle heat. Thinner leathers are treated in a similar manner except that weaker solutions are employed and the time needed is shorter. *Chemicals.*

Morocco. Moroccos are goatskins usually tanned with sumach, either in a vat to which a paddle is fixed which keeps the skins in motion, or by sewing the skin into a bag and filling it with strong sumach solution, and steeping it in a vat which contains more of the solution. They are glazed with a thin solution of albumen and milk, and when dry are polished by means of a cylinder of glass, agate, or hardwood.

Glove Kid. Glove kid is mostly lambskin, though for the best qualities kid is often used. "Chamois" is generally the inner or flesh "split" of sheepskins, though deerskin is sometimes utilized for the finest gloves.

Chamois. In preparing chamois the processes of steeping, liming, scraping, etc. are adopted as usual, and the skins are often split by machine for thin or "wash leather." But instead of tanning in solution as previously described they are placed in a powerful machine, sprinkled with oil, and beaten with heavy mallets working up and down in a kind of trough until the oil is thoroughly beaten into the pores of the leather. Other methods of dressing leather which do not require the process of bark tanning introduce sumach and alum. *Sumach.* Sumach is a yellowish material obtained from the leaves and branches of a plant and is used largely in the preparation of sheep and goatskins.

Morocco. In making morocco leather from goatskins the skins are soaked in lime water, scraped on the fleshy side, and again soaked for a longer period. The hair is then removed by scraping, after which the skin is again immersed. The lime which has penetrated into the pores is removed by a further soaking in an alkaline solution. The skin is sewn into a bag, with the flesh side inwards and the grain side outwards, leaving one opening. The bag is filled with a sumach solution and immersed in a large shallow vessel also containing sumach solution. This is done in order that the solution may act upon both sides simultaneously. In about three hours the sumach converts the skin into leather. It is removed from the solution and laid aside for a while,

after which the seams are opened and the sediment removed. The skins are scraped, smoothed and hung up to dry. When dry it is dyed, well rubbed with a smooth substance to soften it, and finally treated with a grooved piece of wood. This piece of wood, about the size and shape of a lemon, is very hard, and being forcibly applied to the surface of the leather produces those fine lines and wrinkles which distinguish morocco leather.

Where alum is employed the kid- or lambskin is soaked, cleaned, limed and freed from hair as before, after which it is rotated rapidly in a barrel with alum, salt and yolk of egg. In a very short time the leather is taken from the barrel, drawn forcibly over the edge of an upright plate, which process is known as "tawing" and which imparts to the skin that delicate softness which belongs to kid. From the leathers so prepared the artisan fashions boots, shoes, gloves, saddles, harness, belts, bags and a host of other articles known to the children.

Exercises

Exercises. Having made some enquiries into the preparation of leather, and as far as may be examined the things made from it, the class should be allowed to do leather work. The material itself is pleasant to handle, sympathetic and easy to work, while many articles can be fashioned without putting an undue tax upon the capacity of the child. *Suède.* Suède or velvet calf is perhaps the best to begin with, as it is lighter and more flexible than modelling or embossing leather.

Thonging. Leather work of all types involves thonging and it makes quite a good exercise to commence with. Thongs may be purchased ready for use, but it is more thorough to cut them ourselves. If a sufficiently long piece of suède is available, thongs may be cut with a sharp knife upon a sheet of glass or card, using a straight-edge to guide the knife. A more economical plan is to utilize scraps of leather. The corners are trimmed so as to leave a fairly circular form, and a continuous thong

cut with the scissors by working spirally towards the centre—Fig. 46; the thong must be uniform in width, and by cutting evenly at a distance of a quarter or three-eighths of an inch from the edge, a thong of considerable length is obtained from a comparatively small piece of leather. When cut it is pulled and stretched in order to straighten it somewhat.

Punch. The next process is to weave the thong into holes drilled with a punch. The best punch for the purpose is known as a "six-way punch," which is capable of producing circular holes of six different sizes. A spare piece of leather can be utilized for experimenting. Choose the particular punch which is suitable for the thong, and adjust it so that when the handles are forced together the leather is perforated by the sharp cutting edge of the punching tube before it comes to rest upon a pad of brass or aluminium set in the opposite jaw of the apparatus. Some of the various methods of applying the thongs are illustrated in Plate 45, and it should be recognized that besides serving a useful purpose in bending the parts together, the thongs in themselves provide a decorative feature.

Bag or Purse. Having learned the method of thonging, and in so doing acquired some degree of neatness, a simple bag or purse may be essayed. The size and purpose of the article is first considered and decided upon, and a paper pattern cut and folded so that the result may be estimated before commencing upon the leather, as it is disappointing to cut the leather and then to find that it is unsuitable for the purpose. When satisfactory lay the pattern upon the suède and cut round the edges. Fold the material into the desired bag or purse, and prepare for thonging by marking a series of equal divisions a quarter or three-eighths of an inch apart according to the punch to be used and the size of article and thong. It looks richer, however, if the thongs are close together. These points, which are marked with the aid of a ruler, will serve as a guide when punching the holes. When two edges are to be thonged together they should be

punched simultaneously in order that they may coincide when thonged.

The next stage is to add such decoraton as may be desirable. There are two or three methods of decorating soft leather. One is to pierce a pattern in the material *Decoration.* *Piercing.*

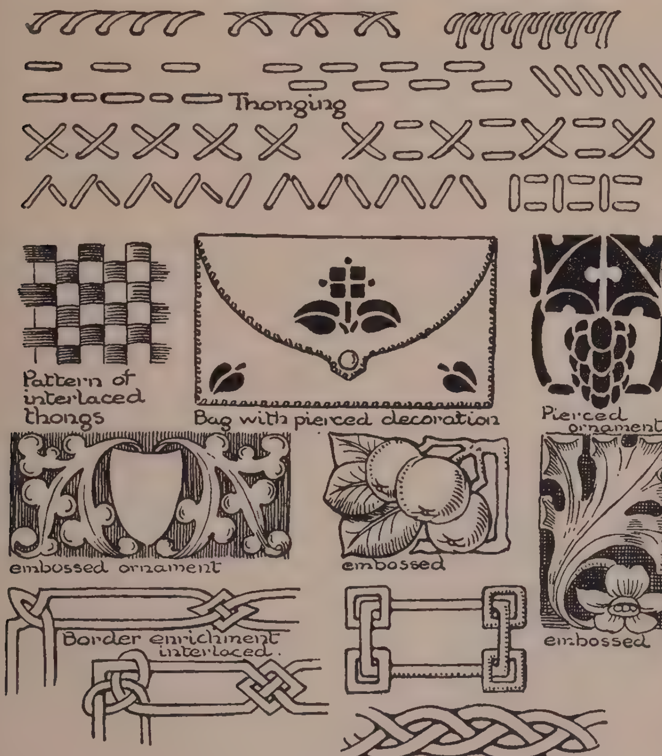


PLATE 45.

in a manner similar to that employed for a stencil plate and to paste some leather of a different colour beneath. Plate 45 shows the type of ornament suitable for this purpose.

Another method is actual stencilling where a stencil plate is designed and cut, and suitable colour pounced through the interstices with a stiff brush. Oil, water *Stencil.*

colour, or stains can be employed provided care is exercised in applying the colour. The brush should be fairly dry, just moist enough to leave a tint when dabbed upon the suède. If it is too wet the pigment will spread beneath the plate and spoil the shapes of the pattern. Stains or transparent colours which do not clog the texture of the leather are preferable to thick oil colour, though if used sparingly the latter can be very pleasant. It may be that the nap or velvet-like texture of the leather is lost in the colouring, but it can be restored by rubbing or brushing when the pigment is dry. A stiff brush or piece of glass-paper gently applied is useful for this purpose.

Appliqué. Still another method is to cut the shapes of the pattern in suède which differs in colour from the ground to which it is applied. These are pasted in position and allowed to dry under pressure.

There is a tendency for the edge of the ornament to rise abruptly from the ground, emphasizing the "stuck on" appearance which is more or less inseparable from this type of decoration. To obviate this the edges may be

Paring Edges. thinned by paring the underside with a sharp flexible knife while the leather rests upon a slab of glass or marble. When the decoration is finished the bag is put together and thonged. One of the principal difficulties in thonging is to dispose of the ends without unsightly

Thonging. knots or protuberances. This is done by passing the end beneath the first three or four thongs, first smearing a little seccotine, paste, or other adhesive over it, and then pulling the thongs tight—Fig. 46. The end will be invisible and also held firmly in place by the thongs above. A press-stud or other fastening device completes the work.

Press-studs. Press-studs can easily be fixed in the class. Tools for this purpose are quite cheap and easy to manipulate, while it is more satisfactory to carry the work through from start to finish than to call in outside aid. "Ruskin stones," which are really shapes of coloured and glazed pottery, can be used for decoration quite effectively.

They may be stuck to the leather and held firm with a few thongs decoratively arranged, or fixed in a setting of metal or leather, which again is thonged to the article.

Modelling or Embossing

Modelling or embossing is a charming mode of decorating leather, besides being one which exploits the peculiar quality of the material. When damp, leather is fairly plastic, permitting of a delicate raising, or depression of its surface, and the forms so obtained are permanent when the leather is dry. The material itself should be carefully chosen, as some skins work easily and sympathetically, while others are intractable and stubborn. A little experience will soon enable the pupils to choose the most suitable for the purpose, though at first the teacher might well assist. Calf-skin, cow-hide, and sheepskin are all useful, though for fine work calf is undoubtedly the best. Cow-hide is generally used for cut work, or for any purpose where a stout leather is needed. *Leather for Modelling.*

A steel modelling tool is essential, together with a sponge for damping the material, and a slab of glass or slate for working upon. With these almost anything can be done, though a small repoussé hammer, a Dresden tool, a knife, and some ground or matting punches will be useful. A few experiments in modelling will render future, more important work easier and less liable to failure. *Tools.*

Having prepared a suitable design on paper, with due regard for the material and the methods to be employed, it is transferred to the leather by means of a hard point. The leather is first damped by passing the moist sponge over the whole surface and the design fastened in position with the aid of drawing pins. Take care not to pierce the leather with the shafts of the pins, unless the pierced part is ultimately to be cut off, as the holes left by the pins are apt to be unsightly. It is better to just clip *Design.*

the edge of the leather between the head of the pin and the drawing board.

Tracing. A hard point is then drawn firmly over the lines of the design, and a perfectly clear impression will be left upon the damp leather beneath, despite the fact that the paper intervenes. When the design is traced, a damp sponge is again passed over the whole surface of the material until it is soft and pliable. Care must be exercised in damping the leather as upon the degree of moisture will depend much of the quality of the work. If the skin is too wet the tool refuses to glide smoothly but drags and sticks, leaving an unpleasant stain and disturbing the quality of the surface. If it is too dry it is difficult to model and takes but a poor impression. It is safer to moisten the whole surface of the leather, as the water tends to darken the tone, especially at first. Later on it is not so essential to cover the whole area, as the wet sponge does not have the same effect, and the part under treatment at the moment may be damped without risk.

Modelling. When the material is properly moistened, the steel modelling tool is pressed upon the background and moved from side to side, and back and fore until the whole of the ground is depressed, leaving the ornament slightly relieved upon it. The tool will tend to polish and also to darken the tone of those portions to which it is applied, adding to the quality and character of the work. The tool should follow the outline of the pattern, beginning a little distance away from the actual line and gradually working up to it. As previously mentioned, the right degree of moisture necessary for the work is discovered by experience. Too much makes the leather spongy, and apt to rebound after being pressed down, while too little leaves it difficult to impress, yet for fine markings a comparatively dry leather is best, as it retains impressions better than damp.

Relief Treatment. When the background is wholly depressed, the ornament itself is modelled, and it is here that good taste and a sense of relief treatment are valuable. The actual

relief is very slight, and the modelling delicate and subtle. Sometimes it is better to keep the edges sharply defined, and again it adds to the charm if the edge is "lost and found" in other cases. The treatment depends upon the type of ornament, and upon the taste and skill of the modeller. Sometimes a little more richness is desirable in some of the forms than is possible to obtain by working from the front; in which case it is pressed up from the back in the following manner.

Embossing. Lay the first and second fingers of the left hand on either side of the form to be raised, with the thumb beneath to grip the leather. Press the point of the modelling tool against the under side until its situation is apparent by a slight boss on the surface. Move it until the boss appears in the correct position and press it firmly upwards so that it stretches the part which lies between the two restraining fingers. This gives a gentle richness to the forms which is pleasing in its subtle variety from the rest of the work.

High Relief. For high relief a lump of clay or wax is useful. Lay a sheet of paper upon the plastic material, and the leather upon the paper. The paper protects the surface of the leather. Press the tool upon the parts to be embossed and the yielding wax or clay will assist in producing the desired forms. For bold work the repoussé hammer is employed, together with suitable punches. For such relief some form of support is needed, otherwise the leather will sag for though capable of retaining a moderate degree, it will not stand very high relief unsupported. *Paste.* Rye paste, in conjunction with fine sawdust or cotton wool, is spread in the hollows on the underside, and a sheet of paper laid over the paste to keep it in place. The paste is used as stiff as may be, or the damp will penetrate and perhaps discolour the leather. In Plate 45 some suggestions for modelled or embossed leather are given. It is useful for the decoration of bags, purses, book covers, blotters, etc., while in conjunction with wood it can be employed for boxes, caskets, frames, and other articles.

Cut Leather. Cut leather introduces the knife. This has a special blade sharpened to a sort of wedge at the tip. The lines to be emphasized are cut about a third or a half-way through the leather, taking care not to go too deep or the work will be weakened. The cut is then opened out with the steel modeller and the outer edge pressed well down until it blends imperceptibly with the ground. After which the modelling proceeds as before.

Colour. Colouring adds considerably to the appearance of the work. Stains, either water or spirit, are the best, as they penetrate the leather and do not affect the grain or texture. Water colour can be used but it is apt to rub off, as the particles of pigment do not penetrate as stain does, while oil colour is somewhat heavy and opaque and is calculated to obscure the essential character of the material. Spirit and water stains must be cautiously applied, as they are strong, and also apt to be patchy and garish in appearance. It is safer to commence with a pale tint and gradually strengthen, as colour can always be added, but once on it is there for good (or ill). Wax polish or ordinary boot polish is good for finishing if briskly rubbed.

Poker Work. Sometimes leather is decorated with poker work, which produces a brown line by scorching the leather with a red-hot point. Special outfits can be obtained with a platinum point kept at the requisite heat by vapourized benzoline blown from a bottle by means of hand bellows.

Tooling. Tooling is another form of decoration largely used for book covers. The tools needed are somewhat numerous, as every form is impressed upon the leather with a tool suitably shaped. Fillets, gouges, circles, dots, stars, spirals, leaf, and flower forms, together with such others as the occasion demands, are needed for tooling. Gold tooling is a further stage, as the gold leaf is impressed upon the leather with the tool after the "blind" impression has been coated with glair or albumen. The work is finally varnished with a leather varnish after a coating of starch has been applied.

This is but a brief outline of the possibilities which lie in leatherwork. The teacher and the pupils will discover many articles which can be made, and also the manner in which they may be fashioned and decorated. A large

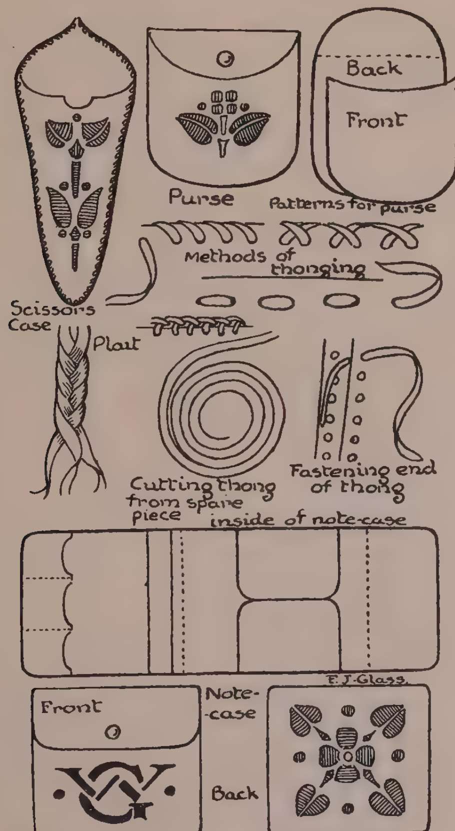


FIG. 46.

quantity of leatherwork is placed on the market, upon which the ornament is stamped by machinery. The difference between this and handwork should be pointed out, as one of the aims of these lessons is to inculcate taste and discrimination. Each child is a potential purchaser and upon the demands of the public depends

to a large extent the quality of the work produced by the manufacturer.

Figs. 46 and 47 give some suggestions for articles of leather together with their decoration, which will come

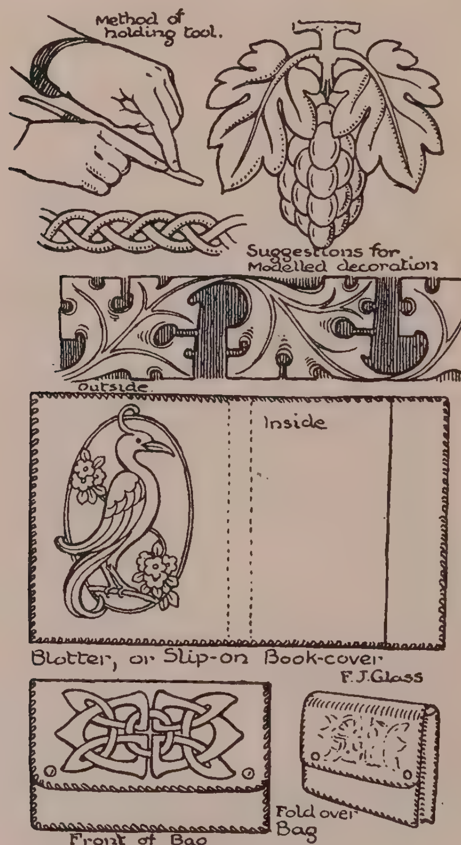


Fig. 47.

easily within the scope of the beginner. There is no need to detail the methods employed as they are obvious enough. Fig. 47 also indicates the manner in which the modelling tool is held. The designs are simple and are included simply to indicate the type most suitable for modelling or piercing.

Space forbids anything approaching an exhaustive treatment, but we hope enough has been written to inspire the teacher to introduce this fascinating craft, and to encourage the children to explore the various avenues of thought and enquiry opened up by the consideration of leather. It is an ancient craft, and a study of its history and of the methods employed in its production and adornment is calculated to prove of great value in the education of the child. It is easy enough to procure examples of leather, and of the things made from it, and the examination of them lends tangibility to the theoretical and intellectual exercises which are based thereon.

Leather working has been practised in England from time immemorial, and in ancient documents we read of tanners, tawers, skinners, cordwainers or shoemakers, and saddlers. Originally, doubtless, the leather worker tanned and prepared his own hides, but in 1351 the tanners and shoemakers ware forbidden to intermeddle with each others' craft. A series of regulations separated the tanners, the curriers, who dressed and "suppled" the rough tanned skins, the tawers and other workers. Oak bark had to be used for tanning, other preparations being forbidden, while further regulations were made to prevent fraud in the preparation and sale of leather. This was partly due to the fact that hides both raw and tanned ranked with cloth as leading articles of trade both home and foreign. There is no space here to go deeply into this useful subject. I have dealt more fully with it in *Leather Craft* and in *Drawing, Design, and Craftwork*.

CHAPTER VI

METALWORK AND JEWELLERY

Pewter. PEWTER is an alloy of tin and lead, or tin and copper, with a predominance of tin. A modern substitute is Britannia metal, a mixture of tin, copper and antimony, the last two in small proportions. Pewter was used very largely at one time for table ware, but nowadays glass and china have almost entirely replaced it. It is really a charming metal, comparatively easy to manipulate, though owing to its low melting point it requires extreme care in soldering.

Tools. A few tools are essential, though an elaborate outfit is by no means necessary. Much can be done with a steel modelling tool, a hammer, a mallet, shears, a couple of rough files, a pair of dividers, and some punches, which can be fashioned from nails or iron rod. To these may be added a piece of felt, a sandbag, and some blocks of hard wood such as oak, or ash, shaped according to our needs. Later on, as the work progresses others can be added, a collet hammer, a planishing hammer, and a blowbipe for soldering.

Brooches, Hatpins, etc. Simple articles of adornment such as brooches, buttons, hatpins, etc., can be executed with the steel modeller, shears, and a few punches only. Boxes, caskets, or articles of wood, can be covered with modelled pewter, or decorated with shapes of pewter fastened to the wood with small nails, which are sold for the purpose. For brooches, metal backs with pins attached, stones, pieces of mother-o'-pearl, or Ruskin stones, are required all of which can be obtained from dealers in these things.

Brooch. To make a brooch lay the metal back upon a sheet of pewter and mark round it; allow $\frac{3}{8}$ or $\frac{1}{2}$ an inch outside

this for turning over, and cut to shape with the shears, or a pair of stout scissors. The next stage is to arrange for the Ruskin stone or other central spot. Lay this in the centre of the pewter and draw round it. This time, however, we must cut inside the line, or there will be nothing to keep the stone in its place. The centre can be cut with a sharp-pointed knife, or with a fretsaw. The saw is fine, like a thin wire, with very fine teeth. First bore a hole in the pewter inside the line to be cut so as not to disturb the margin of pewter which keeps the stone in place—Plate 48.

Fretsaw. Take the fret-frame and fasten a saw into the lower jaws, screwing it tightly into place with the thumbscrew. See that the teeth of the saw are facing away from the frame, and are set downwards so that the cutting is done with the downward stroke. To determine the set of the saw pass the thumb lightly along its edge in both directions. In one direction it will be found comparatively smooth, while in the other there is a decided bite. Place the saw in the frame so that the smooth direction is upwards and the bite downwards. Slip the saw through the hole in the pewter, bend the frame by pressing the top against the bench, and fasten the upper end of the saw into the upper jaws of the frame. When the frame is released it will spring back into place, and so keep the fine saw taut.

Cutting. Cutting the metal requires care as the tightly strung saw snaps easily. Hold it vertical and move it gently but firmly up and down until you feel it is cutting the metal. Don't try to force it if it sticks, but move it gently about until it is free again. A little practice will soon make fretting easy. When the aperture for the stone has been cut, it should be filed or scraped true and even.

Tools. Next comes the decoration, and here we must consider the tools at our command, the nature of the metal, and the purpose of that which we are making. Our tools consist of punches with shaped ends. Some will be circular, others square, oblong, or oval, while others

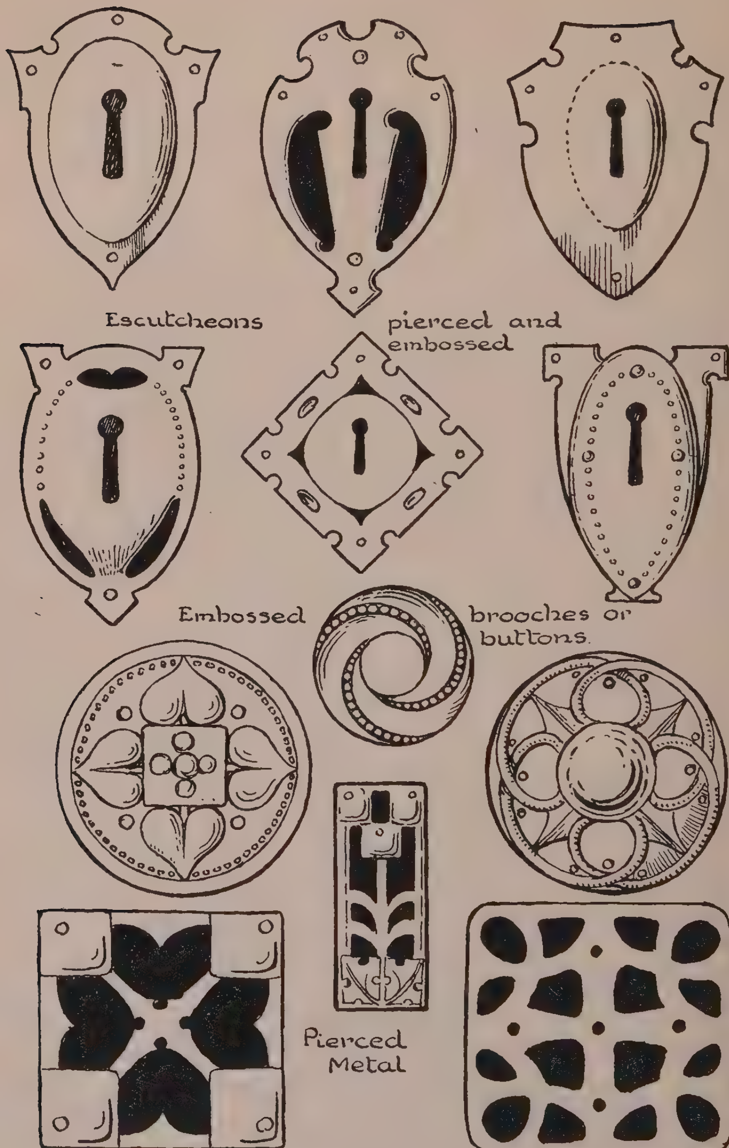

Escutcheons pierced and embossed
Embossed brooches or buttons.
Pierced Metal

PLATE 48.

again may be more elaborate. Simple leaf or flower forms or geometric shapes can easily be filed in the ends of the punches. Generally, however, the simpler they are the better, and the more easily manipulated. If we make impressions of the punches we possess upon a spare piece of pewter we shall see what possibilities there are in them. The impression is made upon the under or wrong side of the metal, which rests upon a pad of felt, so that upon the right side a raised boss appears. From these impressions or bosses we can devise a pattern by arranging them in a pleasing sequence. The ornament thus produced is the logical straightforward outcome of tools and materials, which is just what ornament should be, without undue straining after effects which do not come within the legitimate scope of the process.

Boss Patterns.

Having decided upon the pattern and impressed it upon the pewter, the next proceeding is to fasten the stone in position. It is better to stick it to the back with seccotine or suitable cement before laying the pewter over it. Then place the pewter in position and with the fingers bend the margin gently and evenly over the edge of the metal back. Turn it right underneath and rub it flat with a burnisher or any smooth piece of metal. If the pewter buckles or forms ridges, these can be filed level and again burnished smooth. Hatpins can be fashioned in a similar manner, if the metal base with pin attached is procured. Buttons and even belt clasps in addition to these are quite simple exercises and easily within the scope of most classes.

Jewellery.

Having stimulated an interest in jewellery by way of these practical lessons, an enquiry into and discussion upon purpose, history and methods of production might follow. The ideas which underlie jewellery are sought and discussed. Sometimes it serves a useful purpose, as a means of fastening garments, but more frequently it is adornment pure and simple. Rings, pendants and ear-rings serve no actual purpose, they are simply ornaments and nothing else. The desire for adornment

has its origin in that sense of beauty which is common to all normal beings. However satisfied people may be with their own personal appearance, there is always a desire to add something more if possible. The savage with his nose rings and the ivory and shells which he inserts into his flesh fondly imagines that he is improving his appearance. We who are (or think we are) more cultured and educated are inclined to regard him as ridiculous. But at any rate in his own way, and in accordance with his own ideas and the fashions of his tribe, he is endeavouring to satisfy his æsthetic instinct, and jewellery the whole world over serves this purpose more than any other. It has always been in vogue as far as we can discover, and amongst the articles excavated from the tumuli of prehistoric man are articles of adornment. In every age and clime since then jewellery has been made and worn. Egypt, Assyria, Greece, Rome, India, China, Japan, the Scandinavians and the Celts, and in fact every land and every race has produced jewellery of some kind, generally of a very fine character—Fig. 49.

Æsthetic Instinct.

Jewels. Jewellery should be precious, not merely for its intrinsic value but also for its exquisite workmanship; each article should be a jewel of craftsmanship. Rubies and diamonds are valued because of their rarity, but unless they are beautiful as well as rare, they become curios rather than jewels.

Metals. Platinum is an expensive metal because it is scarce, but it is doubtful whether it is as beautiful as gold or silver, or even copper, could we but rid our minds of monetary standards. But after all is said, it is the workmanship, the value which is given to stone and metal by the mind and hand of man which makes jewellery precious. A beautifully designed and executed ring, pendant, brooch or whatever it may be is far more desirable than even the most expensive stones and metals ostentatiously and blatantly displayed.

Unfortunately, modern machinery has done much to cheapen, and also to vulgarize jewellery. Jewellery

which costs but little is not necessarily vulgar, but when it is mean and paltry, stamped out by thousands and thrown on the market, it becomes appalling. If the

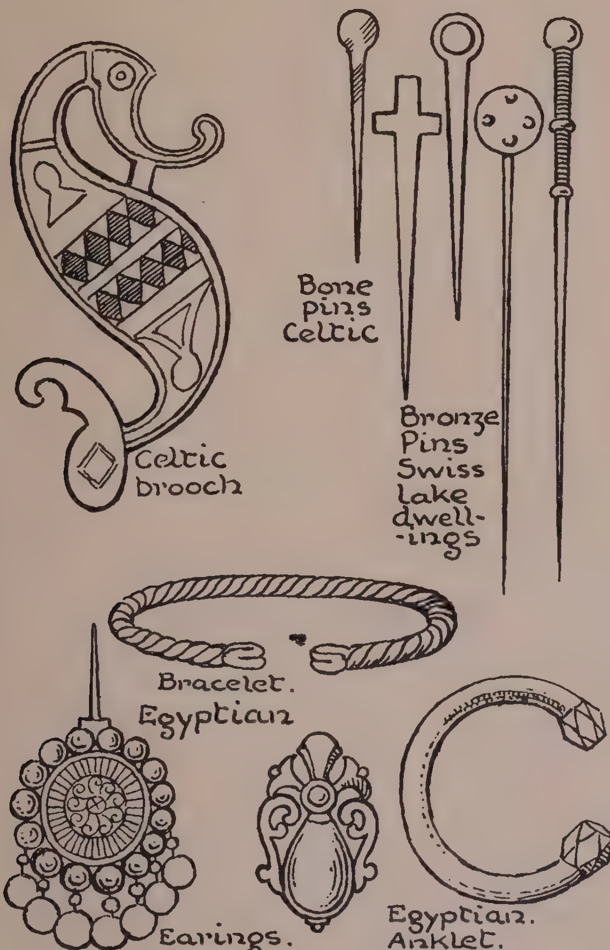


FIG. 49.

designs were not commonplace to commence with, they become so by dint of their sheer monotony. Seen in every jeweller's window and upon every other person

one meets, these things become very tiresome and boring. Instead of buying a jewel carefully and thoughtfully, as a precious thing, we go in nowadays for cheap novelties, which are replaced by other things more novel in a short time. A jewel should be designed for the person by whom it is to be worn. It should at least be an indication of the taste of the wearer (probably it is), if not of the personality, but when fashion is the arbiter there can be little room for individuality. Too often jewellery is designed by those who have never handled tools, stones, or metals, in its manufacture, the consequence being that shapes, patterns, and so-called decorative features quite incongruous to the process and the materials are pressed into service. If it is something strange and unusual, it matters not how ugly it is.

Yet our contention is that design should grow out of the right use of tools and materials, and this is the reason why the children should be encouraged to make some simple things themselves, if only that it may lead them to choose wisely, when in after years they are seeking such articles of adornment. Very few of them, if any, will become jewellers or workers in precious metals, but with them rests the taste of the future, and upon their capacity for differentiating between good and bad will depend the standard of jewellery in the next generation. The æsthetic factor should never be lost sight of in these lessons.

Symbolism

Symbolic Work.

In addition to the ordinary articles of personal adornment there are those which are symbolic, such as the crown, orb, and sceptre of royalty, the mayoral chain, the mace, the seal, the sword, the chalice, the paten, the crosier, and the jewels of various orders, corporations, and bodies. In each of these there is a fund of interest and historic romance. The symbolism which underlies them, the manner in which they originated, and the workmanship involved in them is worthy of time and

thought. Photographs or reproductions of many such articles can be obtained, scrutinized and discussed. History lies as much this way as in a catalogue of dates, battles, and rulers. The crown is a symbol of power, spiritual or temporal, and originated in the feather crests of warriors, and the ceremonial chaplets used at the performance of religious rites, or to adorn the brows of the victor in war or less deadly contests. The bay or laurel wreath was attributed to Apollo and awarded to poets. The myrtle was sacred to Venus, and graced the heads of magistrates and the victors at public games. The ivy and the vine belong to Dionysus and indicate conviviality and plenty. Olive branches suggest peace. Palm means victory or martyrdom, and so on.

Crowns. The earliest royal diadem still existing dates from the end of the sixth century, and is known as the "Iron crown of Lombardy." It is made of plates of gold, ornamented with rosettes, enamels and precious stones, and held together with a band of iron. *Crown of Charlemagne.* Charlemagne's crown is also of plates of gold encrusted with precious stones and decorated with four figures in enamel, Solomon, David, Hezekiah and Christ. *Saxon Crowns.* The Saxon kings of England wore crowns of gold plates. *Norman.* The Norman kings had crowns of jewelled fillets with floral ornaments and so on until we come to the crown worn by our monarch to-day. *Modern.* This is richly jewelled, arched with four semicircular hoops and surmounted with an orb and a cross patée. There are also the coronets of princes, dukes, earls, viscounts and barons, but enough has been said to indicate the thought content of crowns.

Civic Jewels. On the insignia of civic dignitaries is often emblazoned the city or town arms. This has its meaning, though very few of the inhabitants of the place know what the meaning is. Generally it signifies in heraldic language some incident in the history, or some industry or product peculiar to the place. It is remarkable that the folk who dwell in our cities and towns, and who are constantly gazing upon the arms, crests, and mottoes which belong to them, neither know nor care what they mean.

Heraldry. Heraldry is a language of great beauty in which is written volumes of history, but to the great majority the volumes are sealed. A little talk about the arms, badges, and flags of various families, bodies, towns, and countries, illustrated with examples, would certainly serve to elucidate the pages of history. *Symbolism.* Symbolism is interwoven with heraldry, or rather heraldry is a symbolic language, and there are many interesting symbols which might be discussed: The rose of England, the thistle of Scotland, the shamrock of Ireland, and the leek or daffodil of Wales; the lions and leopards which figure in the Royal Arms upon our coinage and elsewhere; the Fleur-de-lis, or lily of France; the square and compass of Masonry; the wheel of Rotary; and the innumerable symbols which are used by societies, bodies, and businesses as badges, or trade marks, will furnish subject-matter for discussion. These things enter into the fabric of modern life and activity, and might well be considered by the class.

Symbols. Religious thought, too, finds in symbolism a means of expression, for spiritual ideas are usually too abstract for clear definition; they can only be suggested by symbols. Our ecclesiastical buildings are rich in symbolic ornament, which can only be appreciated and understood by those who know the language. The trefoil stands for the Trinity, the cross symbolizes the crucifixion; the vine, the shepherd, and the initials I.H.S. (usually intertwined) typifies Christ. The angel, lion, ox, and eagle signify the four Evangelists. The lily indicates purity and the Virgin Mary, the passion flower suggests the passion of Christ, the key means St. Peter, and so on through a long list. Then we have the signs of the Zodiac, the old man with the scythe and the hour-glass for Time, the circle for Eternity, the torch of Life, the mirror of Truth, and the lamp of Learning; with innumerable others to suggest ideas too big, too illimitable to admit of anything but symbolic suggestion. Herein lies food for thought, speculation, and enquiry. All this may seem alien to the subject in hand, but

"any road will take you to the end of the world," and there are connecting links between all branches of thought and activity, hence jewellery leads by easy stages to symbolism, and symbolism to the realm of abstract thought.

Having made some brooches, hatpins, or other simple articles of jewellery in the manner suggested, the attention might be directed towards trays, bowls, or other objects, provided the degree of skill in the child warrants it, and the equipment of the school makes it possible. Another thought is introduced: What is the metal capable of, and what shapes are most suitable to that metal? Again, what purpose is the article intended to serve, and what tools are to be employed? Upon a frank acceptation of our limitations, and upon the answer we give to these questions, will depend the value of the exercise and the beauty of the work. In fact upon these foundations rest all that is artistic in the crafts, and by inculcating a knowledge of, and a keen regard for these factors, we are educating the children in taste, discrimination, and appreciation of honest workmanship.

Capacity of Metal.

The child has learned a little of the malleable nature of pewter by his first exercises. We will adhere to this metal in our further description, though copper might be employed by older and more accomplished pupils. Silver, too, might be used if sufficient skill has been acquired, but as both are more difficult to handle than pewter, we must leave this to the discretion of the instructor. The methods are similar to those indicated for the softer metal under consideration.

Raising.

Simple bowl forms beaten up with a round-headed mallet upon a sandbag, and finished upon metal stakes or specially shaped wood, form excellent exercises. Cut a disc of metal 8 or 9 inches in diameter, and with the dividers strike a series of concentric circles on both sides. Rest the pewter upon the sandbag, and strike a series of blows with the mallet, commencing with the outer circle, and working round each one in turn evenly and uniformly, until the inner circle which circumscribes

the base is reached. This will have the effect of curving the metal into a suggestion of a bowl. The blows must be evenly distributed, and each portion beaten to the same degree as every other, or the metal will be unduly stretched in some places, resulting in an uneven bowl. Should this occur the overstretched parts must be avoided in the next series of strokes, until the remainder has become equally extended and the contour is symmetrical. It is often very difficult to true up a shape which has lost its symmetry, so it is wiser to avoid any undue stretching as far as possible. In hammering, the right elbow is kept close to the body, and the mallet allowed to fall upon the same spot on the sandbag, while the metal (which comes between mallet and sand-bag) is revolved slowly so that each blow of the mallet falls alongside the previous one. If the strokes are evenly distributed within each successive ring upon the disc, there will be little danger of undue stretching in any one part. The bowl will rise evenly and symmetrically.

Annealing. After going completely round the metal from outer to inner circle it will be necessary to anneal or soften it. For this purpose it is safest to plunge it into boiling water for a couple of minutes. Having obtained a slightly rounded shape on the sandbag it will be necessary to obtain a stake of suitable shape upon which to finish the bowl. Hard wood such as oak or ash serves very well.

Raising. Fix a suitable block of wood in the vice, and with a rasp, round one end until it assumes something of the curvature desired for the bowl. Smooth with a file and glass-paper. Hold the metal in position upon the stake, and with the wedge-shaped end of the mallet pull it over the stake. This particular stroke needs a little practice, as the metal is not struck directly upon the stake, so that it is crushed as it were between stake and mallet, but is caught just in front of the portion which rests upon the rounded wood. This stretches the pewter in the correct place, helping it to assume the required form. When it has gone far enough, it will need planishing, because

however careful we may have been, the surface will be somewhat uneven. In planishing the metal is actually caught between the smooth face of the planishing hammer and the stake, which serves better if of metal, though hard wood will meet the case. Needless to say, care and skill are required, as it is only too easy to dent the metal with the edge of the hammer, or by beating where there is no support. Keep the elbow close to the side, and allow the hammer to fall upon the same spot on the stake every time, but shifting the pewter a little after each blow, so that the strokes are distributed evenly and uniformly over the whole surface. The concentric circles will act as guides at first, though they will be obliterated in the planishing. The effect when finished should be a comparatively smooth surface of small facets melting imperceptibly one into another. If dents appear it means that the hammer face is not descending squarely upon the metal, but edgewise. *Planishing.*

To finish the top of the bowl, beat the edge over the angle of a square or rectangular stake. The width of the edge turned over depends upon the bowl and the purpose it is intended for. It may be just enough to strengthen and enrich the top of the bowl or wide enough to be decorated with a repoussé border. It should be at right angles to the sides of the bowl, or at any rate horizontal. *Edge.*

The base must next be trued upon a flat metal stake, and may be hammered inside or out according to the shape of the bowl, and to which is the more convenient. If the bowl is shallow it is possible to rest it upon the flat stake and reach the base inside with a hammer. If it is deep we shall have to insert a suitable stake, fixed in the vice, into the bowl and hammer the exterior. Finally smooth with emery cloth, and polish with soft rags and metal polish, or whiting and water. If desirable the bowl may be decorated with bosses, obtained by means of the punches. Some difficulties may arise here, as both hands are needed for punch and hammer, which makes it awkward to keep the bowl in *Base.*

place. This can easily be overcome by getting someone to hold the bowl.

Snarling. Should the interior of the bowl be impossible to reach with hammer and punch a "snarling" iron is employed. This is a rod of iron bent at right angles in alternate directions at either end like a letter Z. One end is fixed in the vice and the other inserted into the bowl, so that it comes at the exact spot where we desire our boss. The centre of the rod is struck sharply with the hammer while the bowl is held firmly against the end of the "snarling" iron. The rebound of the rod will bring the end into sharp contact with the pewter, raising a boss on the outside—Fig. 50.

In this manner the class is given an insight into the raising of metal utensils. Other methods should be brought to their notice. Many metal objects and vessels are stamped nowadays. Another method much in vogue is "spinning"—Fig. 51. Here a core is made of hard wood exactly similar in shape to the vase, bowl, or other vessel needed. This core or centre is made in such a way that it will come to pieces and so may easily be withdrawn from the inside of the metal, assuming that the shape does not permit it to come away intact. A disc of metal is cut to the proper size and placed in the lathe together with the core, its centre coinciding with the centre of the base of the core. When the lathe is set in motion the craftsman, with a steel tool, gradually presses the revolving metal into close contact with the wooden shape or core.

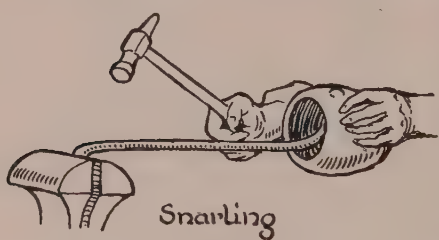


Fig. 50.

Spinning.

It will probably be necessary to anneal or soften the metal a few times during the process. Copper, brass and silver are brought to a red heat and cooled in water. Hammering hardens these metals, and to make

them workable again heat is necessary. Pewter may be softened in a similar manner, but it is dangerous to apply the blowpipe or other flame as it melts so readily. Boiling water is much safer.

In schools where the equipment is adequate for the purpose, many exercises in metalwork can be undertaken. Such articles as scoops, napkin rings, finger-plates, escutcheons, trays, and even bowls, candlesticks and sconces can be fashioned.

The napkin rings in Plate 52 are quite simple exercises in pierced decoration, involving the use of the fretsaw. *Napkin Rings.* Pewter, copper, or even brass can be employed, though of the three copper is the best, being firmer than pewter, but softer and more easily manipulated than brass. First of all the purpose of the object is considered and a suitable size settled upon. A design is drawn upon paper with due regard for purpose, materials, and tools, which is then

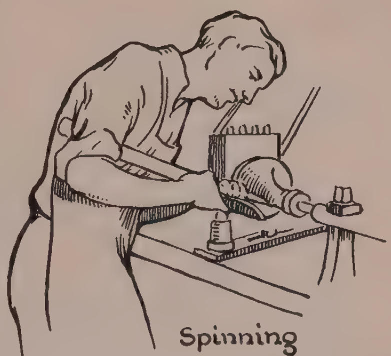


FIG. 51.

transferred to the metal by means of carbon paper. The length of the strip of metal required will be three times the diameter of the ring, with $\frac{1}{4}$ of an inch or so to overlap if a lap joint is to be used. If the butt joint is employed the extra $\frac{1}{4}$ of an inch will not be needed. Having cut the strip of metal and filed it true at the edges, the next stage is to drill holes in suitable places to insert the fretsaw. Screw it tightly into the frame and cut out the required shapes. The procedure is described previously. The square shapes in the first example can be cut with a chisel upon a spare piece of brass or copper resting upon an iron stake. If cut directly upon the iron stake, the chisel is very soon

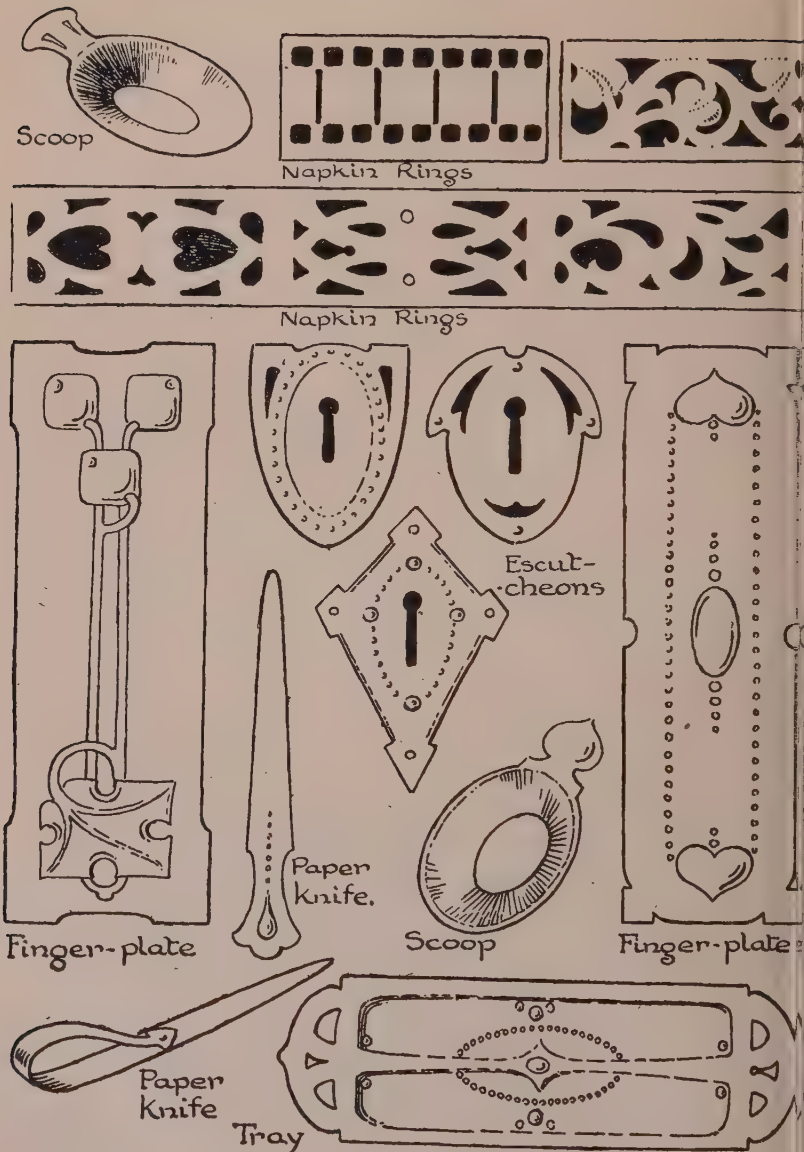

Scoop
Napkin Rings
Napkin Rings
Escut-
-cheons
Finger-plate
Paper
knife.
Scoop
Finger-plate
Paper
Knife
Tray

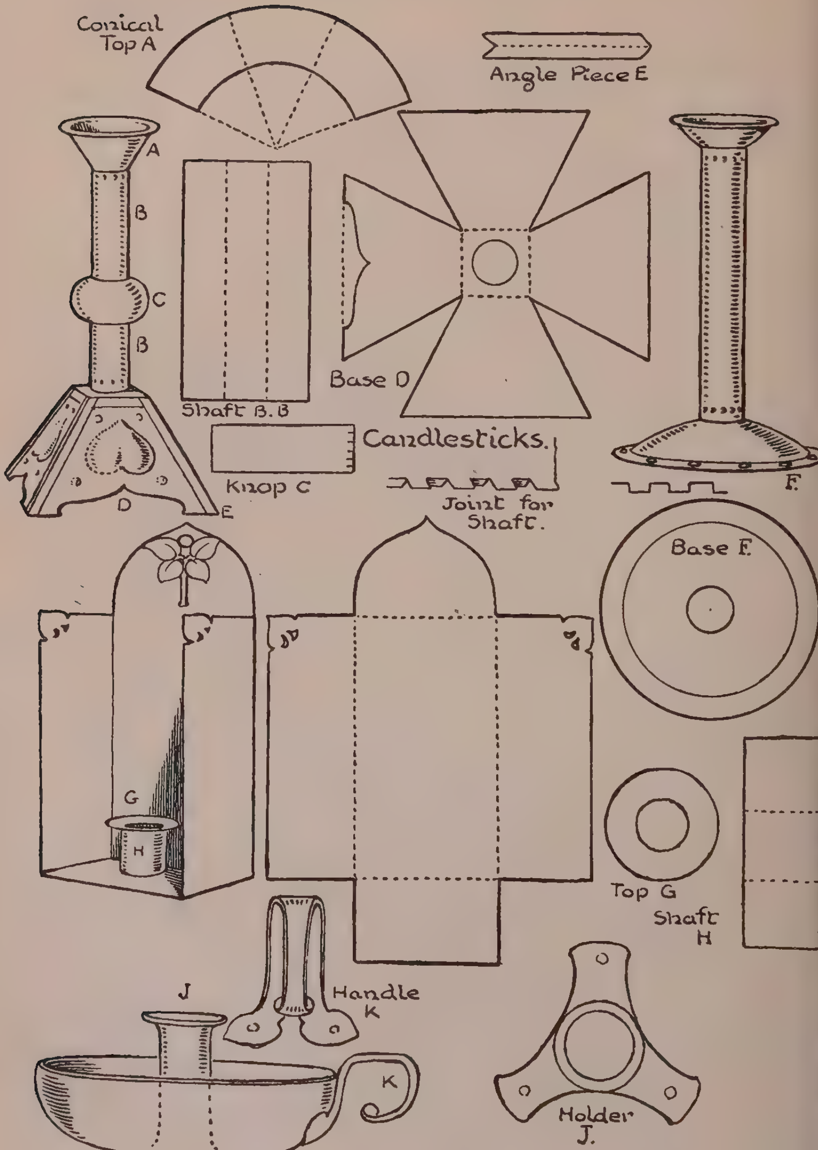
PLATE 52.

blunted, hence it is advisable to interpose a thickness of softer metal.

The escutcheons illustrated are produced in a similar manner, except for the addition of a little embossed or repoussé decoration which is beaten up from the back upon a sheet of lead or a pitch bed if available. The manner of procedure has been described earlier. The finger plates and paper-knives are also quite simple in the light of foregoing lessons. The scoops and the tray involve a little beating up and raising.

Candlesticks. The candlesticks in Plate 53 are more complicated, as a considerable amount of planning or setting out is required for each. The first one is a cylindrical shaft with a knop, and a candle holder with a pyramidal base. The shapes of the pieces required are shown. Each of these should be carefully drawn on paper and the patterns cut and fitted together before the metal is used. We can then see if any alterations in size or proportion are necessary, and can make them more easily than in metal. Lay the pattern upon the sheet of metal and mark carefully along each edge, then with the shears cut the sheet metal to shape. Copper is certainly the best to use. The main difficulty lies in the joints. The one suggested in the sketch in Plate 53 is a good one, where strength is needed. It is made by allowing a quarter of an inch or so on one edge, and cutting snicks therein about $\frac{1}{4}$ of an inch apart. The small projecting pieces so obtained are bent alternately up and down sufficiently to insert the opposite edge into the angle formed between. File this edge down until it is fairly thin, and fit it into place. Hammer the small pieces flat, so that they clip the thinned edge between them. This joint is next soldered to hold it firm. Soft solder is not recommended, though it may be used if hard solder is not available. Thoroughly clean the metal at the joint either with files, emery cloth, or nitric or sulphuric acid diluted.

Soft Soldering. For soft solder smear the parts to be united with "Fluxite," cut some small snippets of soft solder (which



Conical Top A
Angle Piece E
A
B
C
B
D
E
Shaft B. B
Base D
Knop C
Candlesticks.
Joint for Shaft.
F.
Base F.
G
H
Top G
Shaft H
J
Handle K
K
Holder J.

PLATE 53.

can be purchased in thin strips) and lay these snippets alongside the joints. Gradually heat the metal with the blowpipe until the solder distributes itself over the areas prepared with "Fluxite." This is termed sweating, and is easier and more satisfactory than using a soldering iron. A better plan, however, is to use silver solder (which can also be purchased ready for use) with borax as a flux instead of "Fluxite." The "Fluxite" is a substitute for "killed" spirits of salts, which at one time was always used for soft soldering. The spirit is "killed" by introducing zinc, but "Fluxite" is much more handy, and less trouble, as a tin will last a long time and is always ready for use.

Hard Soldering.

It should never be employed for hard soldering, as borax is the most suitable for this purpose. Special fluxes are obtainable but borax is as good as anything, besides being cheap. Clean the parts to be united and paint the joints with a paste made by rubbing a lump of borax moistened with clean water upon a slab of slate or ground glass. Cut some small snippets of silver solder, dip them into the borax paste, and lay them carefully beside the joints. Gently heat the metal until the borax begins to bubble, watch it to see that the particles of solder are not displaced, and replace them if they are. Soon the borax melts and forms a protective glaze over the copper, at the same time holding the solder in place. Play the flame of the blowpipe over the whole metal, bringing it gradually to a red heat, and gently increasing until the solder flashes and runs into the joints. Keep the flame away from the solder, or the brass with which it is alloyed will burn out and the solder refuse to melt.

The cylindrical shafts and sconces are beaten round a suitable round stake. The knop must be joined as we have described by snicking one edge and inserting the opposite edge into the angle formed by bending the pieces so formed alternately up and down, after which the centre is hammered upon a round-headed stake, which causes it to spread, while the edges remain untouched. This gives it the necessary bulbous or rounded form.

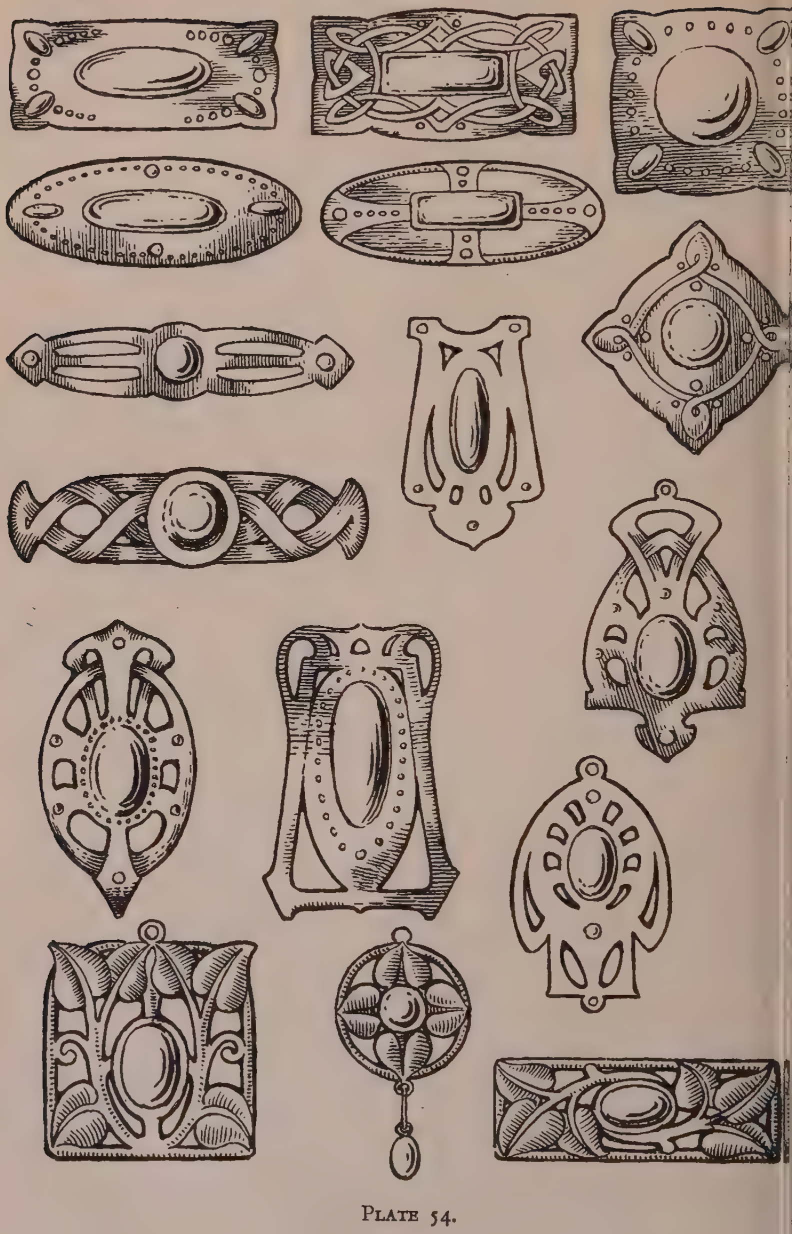


Plate 54.

The bowl of the candlestick at the bottom of Plate 53 is beaten upon a sandbag and planished upon a suitable stake; also the domed base of the top right-hand one. The edges are stiffened by turning over at right angles upon a square-edged stake. This subject of metalwork is very wide in scope, but having dealt with it in *Drawing, Design, and Craftwork*, there is no need to give undue space here.

In Plate 53 are given some further examples of escutcheons, together with other exercises in pierced and repoussé work, which need no explanation. The tools required are fret-saws, punches, needle files, and a sheet of lead to punch upon.

Plate 54 shows some examples of simple jewellery involving stone-setting, piercing and embossing. They are suitable for execution in copper, pewter, or, given sufficient skill and practice, in silver. The aim is to give the pupils an insight into the methods employed and to inculcate an appreciation of good design and craftsmanship.

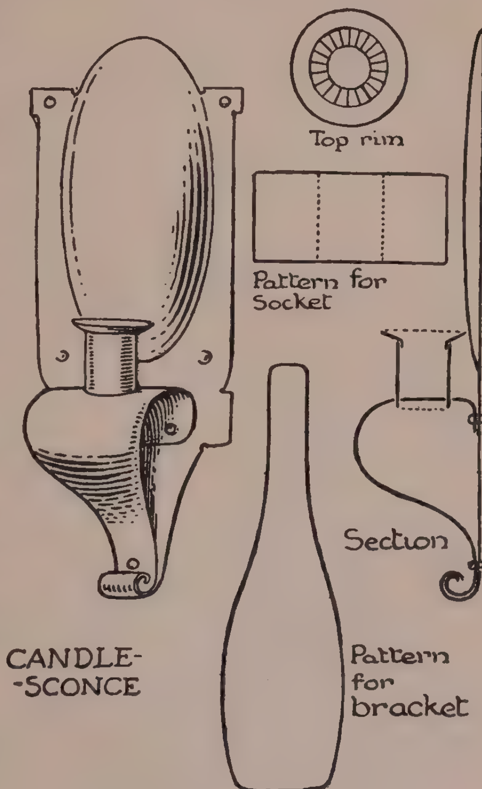


FIG. 55.

The candle sconce (Fig. 55), is not difficult to make. It

is wiser, however, to make paper patterns from the design before starting on the metal. Riveting is involved in this exercise. Rivets can be purchased, or made from stout copper wire by clipping short lengths of wire in a vice and hammering the end until it spreads to form the head. Bore a hole of the correct size through both the pieces of metal to be united, and insert the rounded head into a corresponding depression in the doming-block or a doming-punch fixed in the vice, pass the other end of the rivet through the hole and hammer the end until it spreads and holds the parts of sheet metal together. The drawing explains the shapes needed and the fitting of the parts into place.

The history of metalwork offers a wide range for investigation and enquiry, going back to the Bronze Age, and including every period since that remote time. Fig. 49 gives some examples of pins from the lake dwellings of Switzerland, a Celtic brooch, and some Egyptian jewellery.

Fig. 56 shows one or two other examples of simple objects suitable for pewter or copper. In the light of what has been written there is no need to detail the methods of procedure. At the bottom are three examples of pewter brooches easily executed. Above there are some suggestions for wire units which, when bent and combined in various ways, form an easy introduction to filigree work, which plays so important a part in the making of jewellery. Silver wire of rectangular section is the best, though for preliminary exercises copper wire is useful. A drawplate is needed for pulling the wire through, until it reaches the requisite degree of fineness; these can easily be obtained from tool dealers. The wire is first annealed and the end filed, until it can be passed through a hole in the plate, leaving sufficient projecting to be gripped with the draw tongs, or a stout pair of pliers. A little sweet oil or olive oil is brushed over the wire to facilitate its passage, and it is then pulled through the hole in the plate. It will be noticed that there are a series of graduated holes, and by

Wire Units.

pulling the wire through each in succession it is gradually reduced in thickness with a corresponding increase in length until the requisite section is obtained.

Having obtained the wire we cut a suitable length, and mark that length upon paper, in order that we may be able to cut similar lengths as required. With a fine pair of round-nose pliers we bend this wire into some such form as here illustrated. If satisfactory we proceed to cut further lengths and to bend similar units. If not we shorten or lengthen the wire as may be needed. We then make a number of other shapes until we have sufficient to commence with. By arranging these units in various ways we shall obtain numerous suggestions for design. There is no need here to make preliminary sketches, the design grows out of a logical use of tools and materials. There are endless possibilities and most pupils will find the exercise a fascinating one.

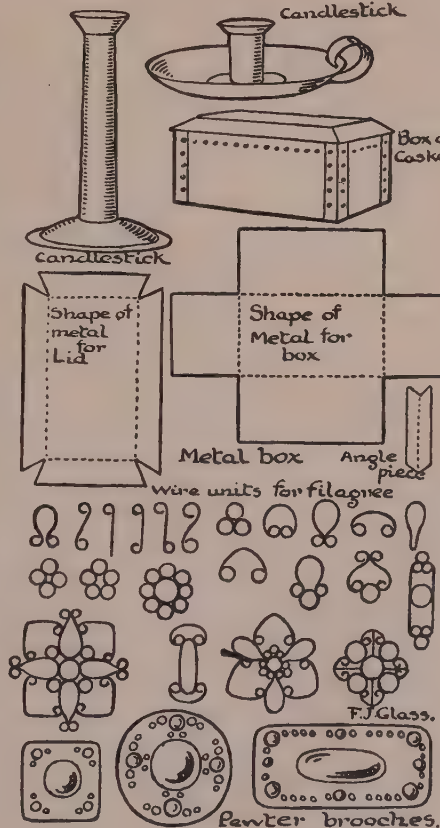


FIG. 56.

To add interest to the design a stone, or spot of enamel, will be necessary. This, of course, will require a

setting. The method of making these is dealt with in *Drawing, Design, and Craftwork*, and there is no space here to describe the process. When the units have been arranged satisfactorily they are soldered with hard solder, using just sufficient to hold the work together and not enough to make it clumsy. Hard soldering has already been dealt with.

Metals have provided man with some of the most useful and valuable materials wherewith to supply his needs. Iron and bronze have furnished him with tools, implements and cutlery, while iron and steel are used to-day for innumerable purposes, ranging from buildings, machinery, and locomotives, down to lancets and needles.

Iron and Steel

Iron. The preparation and manufacture of iron and steel is an interesting subject. In Britain we are fortunate in finding iron and coal in close proximity, so that the working of iron is rendered comparatively cheap. Iron exists in the natural state as "ore," of which there are numerous varieties. The most common in this country is the "clay" ironstone, which is a sort of bluish grey stone. The proportion of iron averages between 40 and 50 per cent., the residue being made up of carbonic acid, silica, clay, alumina, lime, magnesia, and minute portions of other ingredients. After the ore has been mined or quarried according to the situation in which it is found, it is melted to separate the metal from the various earthy matters which accompany it in its natural state.

Blast Furnace. If the pieces of ore are large they are first crushed before being consigned to the blast furnace, which usually consists of a tall, slightly tapering erection of iron plate, lined with fire bricks. The ore, together with limestone, to act as a flux, and coke for fuel, is lowered into the furnace through a cavity at the top, which is then closed with a movable lid. A blast of hot air is blown into the furnace, passing through the substances packed inside,

until it reaches the top when, having become gas, it is utilized as fuel. As the materials burn, or melt, the charge descends in the furnace and the temperature is raised higher and higher until, in a molten state, the iron reaches the base, to be poured off into moulds.

The almost incredible change which is wrought in the state of so hard and durable a substance as iron by the application of intense heat, helps to explain what happened to the earth when it was in process of formation millions of years ago. The molten rock or lava which pours from volcanic fires is more easily understood if we have seen iron in a fluid condition. Such is the titanic force which lurks in the fire, so quietly and amiably crackling and glowing in the fire grate, warming our dwellings.

Nowadays the molten metal is often run directly into iron moulds attached to an endless chain which propels the metal to a place where it is cooled with water. The older method was less expeditious. The molten metal was run into trenches or moulds of sand arranged on the floor about the furnace where it was allowed to cool into "pig iron." This necessitated re-melting the iron before it could be cast into the required forms.

When steel is needed the molten metal is transferred directly to the steel furnace, where it is poured into a "mixer" which stirs the metal and ensures uniformity in the texture and quality. From this it passes into the Bessemer Converter, a large barrel-shaped vessel with an open top, slung from the centre. A blast of cold air is blown in at the base through the molten metal, issuing at the top in a roaring flame which changes from red to white and finally to a feeble light blue. The workman knows by the colour of the flame whether the conversion into steel is complete and satisfactory. The cold blast is stopped and the contents drawn off into ingot moulds. When the metal has cooled somewhat the glowing ingot is shaped into bars, plates, rails or rods by passing them a number of times between *Rolling.*

rollers. The metal remains extremely hot during this process and is gradually forced into shape by a succession of rollers, each succeeding pair making the metal longer and narrower.

Casting. A good deal of work is cast into the desired form instead of being rolled. For this purpose sand moulds are used. Parts of machines and many other things are made in this way; as they are too complex to be rolled or wrought. First of all a "pattern" is made exactly similar to the shape which is to be cast. This pattern is generally of wood, and in order to allow it to leave the sand smoothly and easily, it is coated with shellac. It is next embedded in sand, well packed to *Moulds.* form a coherent and compact mass. The pattern is withdrawn, leaving its impress in the sand, and the molten metal is poured into the cavity, giving an exact reproduction of the pattern it replaces. When cool the casting is cleaned and filed. The usual procedure is as follows.

"Flasks." A flask consisting of two parts, an upper called a "cope" and a lower known as a "drag," are employed to hold the sand in place. The lower half is partly filled with sand and the pattern laid upon it, after which more sand is packed around. The upper portion of the flask is placed in position upon the lower, and damp sand filled in around the pattern, half of which will come inside this portion of the flask. The sand used is damp, and is rammed well in, so that it forms a compact mass. When this part is complete, the flasks are reversed, and the lower portion taken away to be emptied of sand. The surface of the upper part of the mould is levelled and dusted over with dry parting sand. The under portion or drag is replaced and packed tightly around the pattern with the damp moulding sand. The flask is again parted (which operation is facilitated by the parting sand) and the pattern withdrawn. If any part of the surface of the mould has broken away, it must be replaced, and the gates or pours to receive the metal prepared. These are usually arranged for by inserting a tapering peg of wood known

as a "sprue pin" into the sand which is packed around the pattern. The molten metal is poured into the mould by way of the "sprue hole."

Care is needed in the casting of metal or accidents may occur. "Vents" for the escape of the hot air must be arranged, and the mould must be dry, or steam will be generated, causing trouble. Wrought iron is sometimes produced by converting the "pig iron" in a "puddling furnace," where it is subjected to a great heat in order to burn out the carbon.

Forging. Both iron and steel are forged at a red heat by the blacksmith. Hand forging, though still practised, is being rapidly superseded by machinery. The modern blacksmith, instead of relying upon the hammers wielded by himself and his assistant, does a good deal by means of the "trip hammer" and other mechanical tools which, operated by steam or electricity, are more speedy than the hammer swung by hand. The forge of the blacksmith, where it still exists, is always a fascinating haunt for children. They love to see the ruddy glow of fire and metal, and the flying sparks, while the rhythmic ring of the hammer falling upon the iron is music in their ears. "They love to see the flaming forge, and to hear the bellows roar," as Longfellow sings. The village forge is not so easily found in these days, instead of being lured to watch the smith at work, one is deafened and shaken by the mighty hammers which, with titanic power, force the metal into the desired shape with a few irresistible blows. If possible, the children should visit forges or iron foundries in order to see both methods and to compare the old with the new.

Copper

Copper. Copper and its alloys were perhaps the first metals used by man, for bronze is composed of copper and tin, and because it was employed by a people about whom we know little else, it gives its name to those far-off days usually termed the Bronze Age. It is a beautiful

as well as a useful metal, and is both malleable and ductile, and consequently easy to manipulate, while its colour is charming in most conditions. Cornwall supplies most of the copper found in England, but the best comes from Sweden and other foreign lands. The ore is combined with iron and sulphur in its natural state, which need separating before copper is obtained. There are three methods employed: (1) roasting and smelting; (2) dissolving in acid; and (3) electricity.

In the first method the ore is roasted to burn out the sulphur. It is then subjected to intense heat in a blast furnace, termed a "Cupola." The cupola is a cylinder at the base tapering into a cone above to form the chimney. In the lower part is a tap hole for withdrawing the metal, together with others for removing cinders. The ore is melted with coke fuel aided by a blast of air heated to about 800° Fahrenheit.

Another form is the Bessemer Converter, consisting of a cylinder of steel mounted upon trunnions and fitted with an arrangement for tilting so that the contents may be poured out. Air is blown through the molten metal, the condition of which is estimated by the colour of the flame which issues from the top, as in the case of steel. When the ore contains a considerable percentage of gold and silver (as frequently happens) the electrolyte process is adopted.

Electric Process. Large wooden tanks lined with lead and coated with tar are filled with a solution of sulphuric acid, bluestone (sulphate of copper), water and a little salt. A thick sheet of impure copper containing a small proportion of gold, silver and other ingredients is attached to the positive hole of a dynamo. This is termed the "anode." A thinner sheet called the "cathode" is attached to the negative pole, and the two plates are immersed in the acid solution. The electric current is turned on and passes from the anode through the liquid to the cathode. The anode dissolves, the copper passing with the current to the cathode, where it is deposited, while the gold, silver and impurities sink to the bottom. The precious

metals are recovered by means of mercury and acids. The metal thus refined is very pure, as it consists of over 99 per cent. copper.

Rolling. Copper is rolled into sheets of standard gauges between steel rollers. It hardens in the working and is softened by annealing or bringing to a red heat and cooling, either rapidly in water or slowly in the air. In either case it is soft when cool. It is invaluable to the electrician, as it forms an excellent transmitter of electrical current, and the amount of copper wire used for this purpose is enormous. It is also a splendid material for the craftsman, as it is capable of taking practically any form and is pleasant to manipulate.

Brass is an alloy of copper and zinc, the copper predominating. It is not quite so sympathetic a material as copper, as it is less malleable and ductile, and cracks more easily in working.

Bronze is copper alloyed with tin, zinc, and sometimes lead. Copper also yields colouring matter, emerald green being extracted from verdigris.

Bells. Bell metal is copper and tin. Bells are supposed to have been cast in the sixth century, while the monks of Croyland Abbey are said to have possessed a fine peal in the tenth century. Bells are associated with our beautiful old churches, and ancient records contain many references to them. "Great Tom" of Lincoln was made in 1610 and weighed nearly 10,000 lbs. For nearly two centuries it called the people to prayers, after which it was replaced by another "Great Tom" which weighed nearly 12,000 lbs. In 1845 a bell was cast for York Minster which weighed over 27,000 lbs., while the great bell of St. Paul's is between 11,000 and 12,000 lbs.

Casting Bells. Bells are cast in a manner similar to that used for other purposes. A core or inner mould is built up, after which an outer mould is constructed, leaving a space between equal to the thickness of the bell. This space is filled with molten metal, which is allowed to cool before the mould is removed. Edgar Allan Poe has written a poem about "Bells" and each verse vibrates to the music

of the particular bell which inspired it. Its word music is haunting and melodious as befits the nature of the theme.

Bronze

Bronze Casting. Bronze is often cast by the "cire perdue" or waste wax process, particularly statuary. Here a mould is made of the figure or group of figures to be cast in bronze. Generally this is a piece mould which can be removed from the original without injury. When the mould is complete the interior is given a coating of wax equal in thickness to that required for the bronze. The mould is then fastened together firmly, and a core or inner mould constructed inside the wax. This core is held in position with bars or pins of bronze passing from one mould into the other. Heat is applied in order to melt out the wax. The workman can tell when sufficient has left the inside, which quantity will be somewhat less than was used in coating the mould, as part of it is absorbed thereby. Into the space left between core and outer mould the molten bronze is poured and allowed to cool. The moulds are removed and the surface finished with chisels and files. This method is practi- *Cellini.* cally the same as that practised by Benvenuto Cellini when casting "Perseus." He gives a fascinating account of the trials and troubles which he had to overcome during that operation, in his *Memoirs*.

Coins. Coins are worthy of consideration, at least most people seem to think they are. Intrinsically they are not so valuable as they seem, for it is only what we can get in exchange which makes them useful and desirable. Robinson Crusoe discovered the truth of this when living alone upon his island with no shops or people to buy from. Euripides says, "Once a man be done with hunger, rich and poor are both as one," which suggests that the mere accumulation of wealth is but a poor aim after all. Yet unfortunately it is only too common. Coins, however, greatly facilitate the exchange of useful commodities. They enable us to

set a standard of values whereby the price of an article can be estimated more readily than by the old system of exchange.

Barter. Exactly when barter was replaced by coins it would be difficult to say, but we know that the Greeks and the Romans had a system of coinage. Coin moulds or dies used during the Roman occupation of Britain have been excavated, together with many of the coins themselves. Each country has its own set of coins and values, which differ in some respects from that of other countries, but this is no place to enter into the subject, as it is enough to deal with our own.

Greek and Roman Coins.

British Coins. Our present coinage was designed by Bertram Mackennal, while in the previous reign it was the work of Sir Thomas Brock, who is also responsible for the memorial to Queen Victoria which faces Buckingham Palace. Each monarch has his or her portrait in low relief upon the obverse side of the coin, while the reverse is occupied by the Royal Arms, or some national heraldic device, or by a symbolic figure of Britannia. The sovereign and half-sovereign (rarely seen nowadays) bear a low-relief rendering of St. George slaying the dragon. Notes have replaced these coins. The coins we use are made at the Mint of London.

Minting Coins. The metal is supplied in oblong bars, which are heated and passed through rollers which crush them down to about one third of their original thickness. They are then passed through cold rollers and reduced to nearly the thickness required for the coins, after which the metal is drawn through a draw plate on the draw bench, and brought to the required thickness in a smooth, hard, uniform condition. They pass to the cutting-out machine and are cut to the required size and shape, after which they are weighed and tested for flaws. The edges are raised, the metal annealed or softened, and the discs pass to the stamping-presses where under pressure the reliefs are stamped on both sides and the edges milled simultaneously. This is the process employed for silver and gold, but it also applies to

bronze except for the milled edge. This is a brief outline of the methods which obtain to-day. Medals are produced in much the same way, and there are many beautiful examples of the medallist's art, some of them dating back to very early days.

Benvenuto Cellini and his contemporaries produced some exquisite specimens of work in this branch. Benvenuto has described the manner in which he worked in his treatises upon the arts. Coins and medals are first modelled in clay, wax, or other plastic material, after which they are cast in plaster, and from this cast a mould or die is made.

Casting. For coins or medals of which a large number are needed, metal dies are prepared, and the bronze, silver, or gold stamped into shape between them. In order to obtain a clear idea of the process, the children might attempt a simple modelling in low relief using clay or plasticine. When finished mix some plaster of Paris by allowing it to trickle gently into a bowl of water until it appears just below the surface. Allow it to stand for a few moments and stir briskly. Erect a wall or enclosure of clay about the work and pour the plaster over the modelling. Allow it to set, then remove the clay and prepare the mould with a weak solution of soda. While still wet mix a sufficient quantity of plaster and fill the mould. Allow time for setting, then separate the two. A few taps with a mallet should do this, though it may be necessary to insert a few wooden wedges into the joint and tap each gently in turn, pouring water over the plaster during the process.

Clay Moulds. Another plan is to choose a coin upon which the relief is clear and distinct. Press this well into a smooth slab of clay or wax so that it leaves a sharp impression. Remove the coin and pour some plaster into the cavity in the clay and allow it to set. We have now a plaster replica of one face of the coin. It is quite possible to obtain a metal replica by using lead, and this should be undertaken if possible.

Lead Casting. Make a plaster mould, as previously described, of

either a coin or the modelling executed by the pupil. Allow it to dry thoroughly until all the moisture has evaporated. Place it in the oven or near a fire so that it is quite warm when used for casting. Melt some lead in an iron ladle or other vessel and pour gently into the mould.

Electro-typing. Medals are often electrotyped, and for this purpose a plaster mould is quite useful. The mould upon which a deposit of metal is required is coated with plumbago or blacklead. A copper wire is fastened round the mould and the wire attached to the negative pole of an electric battery, thus forming the cathode. A sheet of copper is attached to the positive end to form the anode. The anode and cathode are immersed in a bath containing a solution of sulphuric acid, copper sulphide and water, and the current switched on. The sheet of copper will dissolve and deposit itself upon the prepared surface of the mould. It must be allowed to remain for a considerable time in order to obtain a substantial thickness, after which the copper is separated from the mould and backed with lead or other metal in order to strengthen it. If sufficient copper is deposited there is no need to use any other metal for backing. If the school equipment is such that electrotyping is possible, experiments should certainly be undertaken. Care and a little experience will soon enable the student to produce good work. The work is better if it proceeds slowly, because too strong a current is calculated to deposit the copper in a granular, loose form instead of close and compact.

It is also possible to rub or press thin sheets of pewter or copper into plaster moulds if the metal is annealed from time to time as the work proceeds. Punches of steel, or implements of bone or even hard wood are useful for this purpose. The plaster used for the moulds must be of good quality and may be hardened by adding a little powdered alum or a solution of gum arabic to the water when mixing.

Each of these exercises is calculated to produce a clearer understanding of the processes involved than will

any amount of reading about them, or study of the coins or medals, or description by the teacher. Hence it is advisable to adopt some form of actual work in addition to study and investigation. Enquiries into the numerous articles made of metal, and the purposes for which each is used, will lead to many useful and valuable lessons. Saucepans, kettles, and cooking utensils, cutlery, machinery, engines, steamships, bridges, and other work in iron and steel. Jewellery, coins, medals, and other branches of gold and silversmithing. Lists of such articles might he drawn up and their purposes and manufacture discussed by the class. Combined with the exercises here suggested, together with others which will occur to the teacher as the work progresses, these lessons can hardly fail to be of great educational value.

In the Middle Ages English metal workers had a wide reputation for the excellence of their craftsmanship. To-day the iron and steel produced in this country is known and valued the world over. If only for this reason a knowledge of metalwork, what it is, how it is done, and what has been done, should prove of great value in education. We have merely hovered upon the fringe of this huge subject, but we hope that enough has been written to suggest to the teacher some of its possibilities.

So important has metal been in the evolution of the human race that two of its most important epochs have been named after metals, the Bronze Age and the Iron Age. The enormous strides taken by man after he discovered how to work metals have perhaps been unequalled, until he found out how to use steam, and steam would have been valueless had he not been able to control it by using metals. Such was the influence exerted by the use of bronze in prehistoric times, while it is hardly too much to claim that we are still in the Iron Age, though perhaps it would be more correct to call it the Age of Steel. Never was steel used for so many purposes as it is to-day. Its uses are multitudinous and

multifarious. Buildings are erected mainly of steel. Ships, locomotives, motors, bridges, tunnels, gasometers, huge tanks, piers, viaducts, boilers, machinery of every kind, and so on down to such things as knives, razors, lancets, and needles, are fashioned from steel.

History is wrought in metal, if we had time to trace it, for every nation and every age has produced its own peculiar types of work in metal. It is a substance which lends itself equally to utilitarian and to æsthetic purposes. Side by side with saucepans, stovepipes, pokers, and buckets, we have the most exquisite examples of jewellery, made for no other purpose than to gratify man's love of beauty and of fine craftsmanship. It can be fashioned into a towering monster, endowed with titanic force, like some of our modern machinery, or on the other hand it can be wrought into the daintiest filigree. "He who blows through bronze may breathe through silver," as Browning says.

CHAPTER VII

TOOLS

The study of tools takes us to the fundamental basis of the Industrial Arts and also, to a large extent, of the development of the human race. As soon as prehistoric man had evolved to the stage when he supplemented his own members with sticks, stones, horns, or other adventitious aids, he placed himself upon a plane higher than that of the other animals. Prior to the adoption of such aids he must have gone in terror of many of these, because they were so much better equipped by nature for life's struggle. With tools (including weapons) man gradually obtained the ascendancy, until in due course he practically dominated the animal kingdom. Some species have entirely disappeared, others have become domesticated or trained in the service of man, while those which are still wild are but little feared by a well-armed man. "Man is a tool-using animal," says Carlyle, and there is no gainsaying his dictum. Minus tools he is the weakest of creatures, with them he becomes the most powerful. His superiority in intellect has found its most adequate expression by way of tools.

The examination of the tools and implements used in the class, or for such purposes as the child may be acquainted with, will form the nucleus of many enquiries and discussions. The pencils used by all children

Point. suggests the use of the point, and leads to a consideration of the sharpened stick with which the prehistoric potter incised his simple patterns, and by easy stages, to all writing and drawing implements, to spears, needles, drills, and other pointed tools and weapons. In

Plate 57 an early bone needle is illustrated, proving that even the earliest people sewed. *Needles.*

The hammer is a common and widely-used tool, which figures in most crafts, and was one of the first tools to be invented. Exactly what form the first hammer took, or how the idea of adding to the striking force of a stone, or lump of metal, by fastening it to the end of a shaft, occurred to man, it would be difficult to say. It is sufficient to know that the idea did occur, and that in due course it led to implements of great utility and precision, such as the numerous types of hammer which have been used from time immemorial and are still used, culminating in the power-propelled, Cyclopean hammers of modern times. A list of these might be drawn up and their purposes discussed. The hammers and mallets used by the carpenter, the stone carver, the wood carver; the light, dainty hammers used by the jeweller, and the heavier ones used by coppersmiths, tinsmiths, and blacksmiths, will furnish food for discussion. The evolution of the hammer from the early forms shown in Plate 57 to those in use to-day will take us far into history. *Hammer.*

In the Stone Age, hammers and axes of flint were used. Having fashioned the head by means of a stone striker they fastened it to a shaft of wood, or a reindeer's or stag's horn, with thongs. A few have been found perforated, so that the shaft could pass through the centre of the head, like the modern hammer, but in the Stone Age these were rare. In the Bronze Age, however, they were more common, as it was easier to fashion the metal in this form than the more brittle stone. Axes have been discovered in thousands in the bed of the Thames, the Somme, the Marne, and other rivers, belonging to prehistoric times. Plate 57 shows how finely shaped were some of the tools of this period. *Stone Age.* *Bronze Age.* *Axes.*

The terms Stone Age (paleolithic and neolithic), Bronze Age, and Iron Age, do not denote divisions of time, but rather stages of human development which succeeded each other without coinciding in all parts

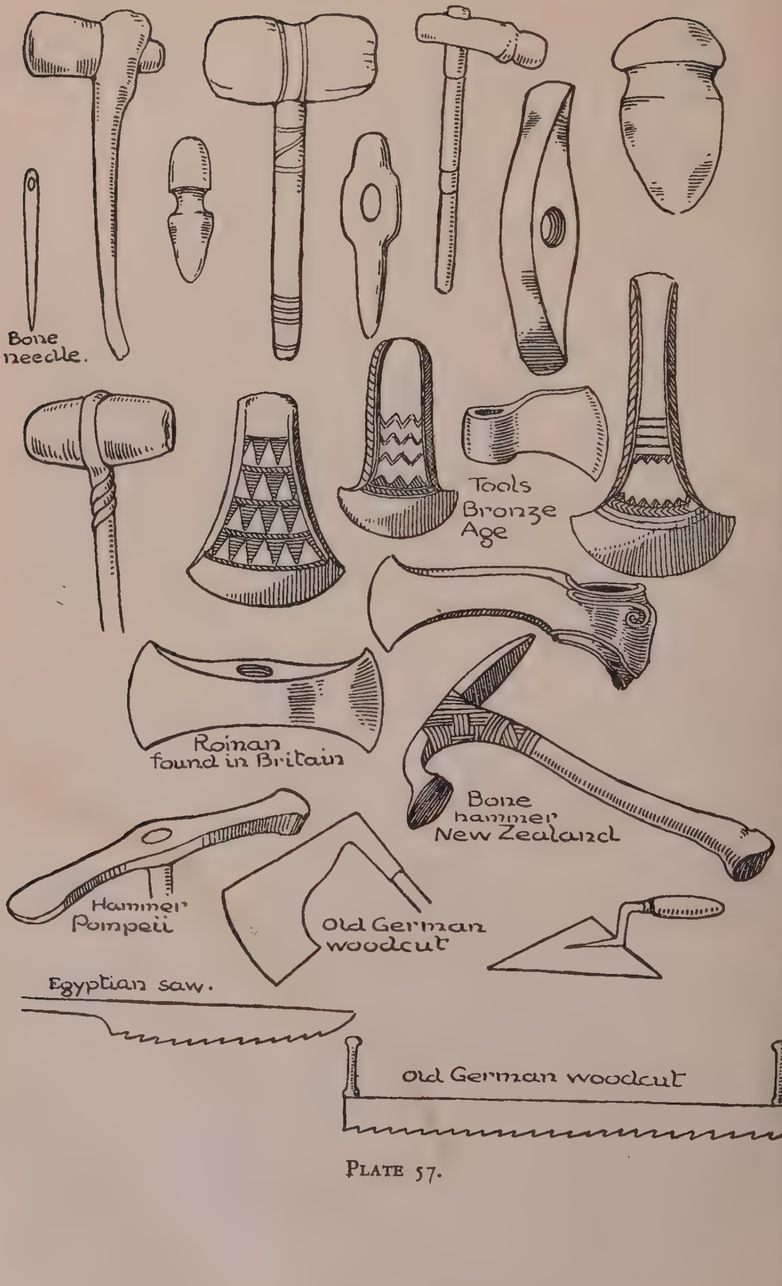

Bone
needle.
Tools
Bronze
Age
Roman
found in Britain
Bone
hammer
New Zealand
Hammer
Pompeii
Old German
woodcut
Egyptian saw.
old German woodcut

PLATE 57.

of the world. Communication and intercourse between different peoples was necessarily more restricted than in these days, but there were recognized roads, or tracks along which trade and intercourse proceeded, and ideas which sprang into existence in one place percolated gradually into others. The progress of these ideas was perforce tardy, hence the stages of development indicated by the above names were not coincident in all countries. The celts and tools of the Bronze and Iron Ages, and those in use in Egypt, Greece, Rome, and other countries and other times, opens up a vista of enormous width.

Fire

Iron Age. Fire.

The working of bronze and iron introduces fire, without which it is well-nigh impossible to manipulate these metals. Fire has been one of the most valuable servants of the human family, though on occasion when it has broken loose it has proved itself a ruthless and devastating force. When it takes hold of a forest, or a prairie, or even buildings, it is exceedingly difficult to subdue, as long as there is food for its consumption. The Fire of London was of so frightful a nature, and so devastating in its effects that it stands with the Roman Invasion, the Norman Conquest, and other great events to mark the pages of history. The burning of Rome at which Nero is said to have fiddled, is another fire recorded in history, also the destruction of the library at Alexandria.

How was fire, or the method of producing it, discovered? It would be impossible to say exactly how or when. Perhaps it was the result of chipping flints in order to make tools. It is possible that a spark falling upon dried leaves or other inflammable material may have smouldered for a while and finally burst into flame, fanned by the breeze. Its congenial warmth would doubtless appeal to the early savage, and would induce him to make other attempts when the first fire had died out. On the other hand, it may have resulted from friction while he was engaged in drilling a hole in some

Fire-Drill. dry wood. Savage tribes to-day use a fire-drill consisting of a rapidly revolving stick working in holes in two pieces of wood, and so producing sufficient friction to ignite tinder or touchwood. Sometimes the drill is revolved between the hands, while one pointed end is inserted into a hole in a piece of wood. Sometimes a bow or a strap drill is used—Plate 60. Once discovered, the uses and possibilities of fire would reveal themselves by degrees. Cooking, firing pottery, melting and working metals, etc., in addition to its comforting heat and light, and the protection it afforded against marauding beasts.

Fire has played an important part in the evolution of the human race. Metals, which without its aid would be practically useless, are by means of it, made to serve innumerable purposes. Steam is produced by it; while little, if any, of our machinery would exist but for fire. It is easy to understand how the awe and reverence in which this elemental force was held led primitive people to adopt fire worship. There is something mysterious and awe-inspiring about its power, and its capacity for reducing matter to ashes, or to a molten state, which despite all the explanations of the scientist, is calculated to arouse wonder even in this sophisticated age. If it strikes us in this manner when we have learned what it is, how it is caused, and how to control it to some extent, we can imagine what effect it would have upon primitive minds in the days when science was unknown, and reason itself was only beginning to dawn. Children are always fascinated by fire, and despite the knowledge acquired by generations of forefathers, have still to learn by experience that fire burns when touched.

Light and heat are suggested, and it would seem appropriate to study the various vessels and articles used for *Artificial Light.* this purpose. Perhaps the first people to use artificial light were the cave dwellers, for in one of the caves *Stone Lamps.* of Perigord a stone lamp was found engraved with the representation of an ibex. In such lamps as these they burned the oil extracted from the fat of deer.

Plate 58 shows an Egyptian lamp in which oil was used, while the wick, inserted in the spout, with its lower end in the oil, was ignited to give illumination. A Roman lantern, torch, and candelabra, are also shown. The lantern is of copper, which at one time held the laminæ of horn, glass, or bladder, which formed the semi-transparent case. In the centre is the small lamp, pierced for the admission of air. The candelabra or candlestick is of bronze. The torch or flambeau *Torch.* would contain some inflammable material, which when lighted would burn readily. The drawing is taken from an ancient gem, upon which, together with their sculpture, the Romans engraved many of these. In symbolic art the torch signifies life, while if reversed it stands for death. The cresset was a sort of metal basket in which resinous woods were burned. In old drawings they are sometimes seen held by sentries, or soldiers on guard at night.

We have touched upon the fire-drill, which by friction causes heat and fire, and we have seen that two flints brought into sharp contact will produce sparks. These two methods in some form or other are the means by which fire is produced. Many savage people use the fire-drill, while others use the flint and steel, which was *Flint and Steel.* the precursor of modern matches. Flint is exceedingly hard, and when struck obliquely against a piece of steel, it strikes off minute particles of white-hot metal, these constitute the germs of heat and flame which ignite the combustible material upon which they are allowed to fall. In the earliest form of muskets a flint and steel was used to fire the gunpowder. If the lock of one of these old weapons be examined the manner in which the flint and steel were brought into contact will be seen.

Quite a number of smokers carry a small contrivance based upon the flint and steel, which they use for lighting pipe, cigar, or cigarette. This consists of a small roughened wheel lying in contact with a piece of flint. Behind is a cotton wick soaked in petrol. The wheel is revolved quickly, causing friction against the flint.

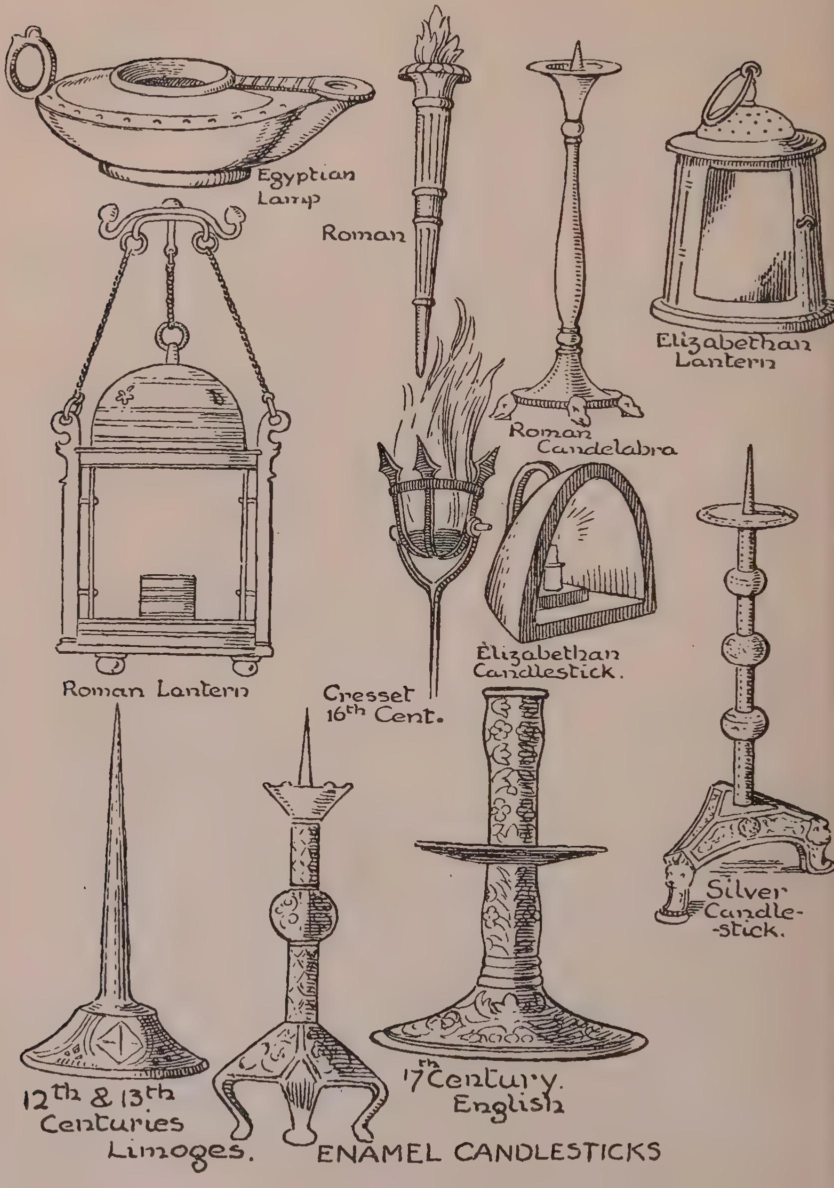

Egyptian Lamp
Roman
Elizabethan Lantern
Roman Candelabra
Roman Lantern
Cresset 16th Cent.
Elizabethan Candlestick.
Silver Candle-stick.
12th & 13th Centuries Limoges.
17th Century. English
ENAMEL CANDLESTICKS

PLATE 58.

The sparks ignite the saturated wick, which bursts into flame. It is easy to obtain one of these in order to demonstrate the principle.

Matches. Matches have passed through various stages before the present serviceable type was evolved. At one time it was necessary to carry a bottle or tube of phosphorus with a box of matches. These were tipped with sulphur and needed pressing against the phosphorus before they were prepared for rubbing against a cork, by which the match was kindled. Now we simply take one from a box, rub it against a prepared surface, and a light results. Here we might mention the dangers which threatened the makers of matches, especially in the early days before means were discovered to cope with "Phossy jaw," as the disease was called.

Candles. Candles were largely used until gas and electricity supplanted them. It would be quite easy for experiments in candle-making to be carried out in the class. *Making Candles.* Melt some white paraffin wax in a tin or other suitable vessel. Take a length of twine or fine cord and dip it into the wax. Allow this coating to set, and then dip again, repeating the process until the candle is of the desired thickness. An experiment of this type will give a clearer idea of candle-making than will all the description of which the teacher is capable.

Faraday's *Chemical History of a Candle* is well worthy of study as it proves how fascinating is the story of common things, when told by a person with knowledge combined with imagination. There is romance in the commonplace if we could but see it, if only our eyes were not blinded by the mists of use and wont. Herein lies the value of such lessons as are here suggested. We take some article of common everyday use, and we endeavour to trace its relationship to other things, its genealogy, the history of the family, and the disposition of its members over the face of the earth. Whether the commonplace becomes romantic depends upon the treatment it receives at the hands of teacher and pupils.

From the Irish bogs is obtained a hard strong wood

known as candlewood, which burns so well that they make torches of it.

Tallow. Tallow is derived from animal sources, and was made into candles by dipping lengths of cotton in the molten fat as previously described. They were known as tallow dips and were formerly used in coal mines, but have since been replaced by Davy lamps and other safer forms of illumination. Electricity is much used nowadays.

Tallow Dips.

Stearin. Stearin is a cleaner, harder form of wax than tallow. The fat or tallow is boiled with quicklime and made into a sort of soap, which is decomposed by sulphuric acid to remove the lime, leaving the fat in the form of stearic acid, together with a quantity of glycerine. The oil is pressed out of it, leaving the substance, which is cast into candles.

Casting Candles. Note the term cast in this case, not dipped as previously. A frame containing a number of moulds is employed. Wicks are passed through and fastened at top and bottom. The stearin is melted and poured into the moulds. When the tallow has set, it shrinks and is easily withdrawn. Another method of making wax candles is to hang a series of cottons upon frames, each cotton having a metal tag fastened to the ends to keep the wax from adhering. The molten wax is poured down each thread in turn, until the last one has been treated. By this time the first has cooled sufficiently to receive a second coating. Proceeding in this manner until the required thickness has been obtained, the workman produces wax candles. They are then rolled upon a smooth stone slab, the tops are shaped with conical tubes, and the bottoms trimmed flat. Candles are not used to anything like the extent they were, because oil, gas, and electricity, have replaced them.

Candlesticks. Candlesticks of different types are illustrated in Plate 58. Much beautiful work has been done in metal, glass, pottery, etc., in the form of candlesticks. Pictures of these may be obtained and discussed in the class.

Oils. Oil from vegetable, mineral and animal sources has

been employed for lighting purposes. The Eskimos light and warm their snow huts with oil extracted from the blubber of the whale. Oil is extracted from olives, linseed, myrtle, arachis (or ground nut of the West Indies), the palm, the tallow tree of China, and other vegetable sources.

Street Lighting. It is interesting to compare modern methods of street lighting with those which obtained, or did not obtain, in bygone days. Until about the beginning of the fifteenth century there was no provision for lighting the streets of London, except by the torches and lanterns carried by wayfarers or placed by the inhabitants outside their houses.

In 1416 Sir Henry Barton, the Mayor, ordered lights to be hung out in winter from Allhallows to Candlemas. For three centuries or so this system, or lack of system, obtained, for the citizens obeyed or disobeyed according to whether patriotism or parsimony dominated in their minds. In 1690 it was ordained that every housekeeper should hang out a lamp or lantern every night as soon as it was dark from Michaelmas to Lady Day and to keep it burning till midnight. In 1736 the corporation applied to Parliament for power to set up a number of glass lamps to be kept burning from sunset to sunrise throughout the year. Five thousand lamps were erected within the city.

In this manner began street lighting, which has since been carried to the extent we know to-day. London at night with its illuminations is like a town we might imagine figuring in *The Arabian Nights*, while some of our provincial towns are not far behind. Most of this is of course due to the extraordinary progress in electrical methods of lighting. Much more might be written on this subject, but space forbids, if we are to get through with tools. Hammers have been mentioned.

Saws. In Plate 57 is a saw used in ancient Egypt, proving that even in those early days the cutting value of fine teeth had been discovered. But the discovery was made even earlier, for among the objects found in the Swiss

lakes, under the peat, belonging to the lake dwellers of the Stone Age, were flint saws. These are small, usually only two or three inches long, and are fixed with a dark-coloured cement into the groove of a handle of wood.

Chisels, Gouges. Chisels or gouges, too, have been excavated belonging to the Stone Age which are similar to those employed by the North American Indians to hollow the tree trunks into canoes. *Stone Age Tools.* Axes, arrows, daggers, drills, fishhooks, and harpoons of flint, bone and shell, lance heads, pestles and mortars, pipes, needles, razors, and even flutes of bone (so some authorities claim), have been found which date from the Stone Age.

It would seem that most tools were invented long ago, they have simply been improved upon, until machinery was invented, and even this is really a complex tool which does more rapidly the work of the hand tool. Plate 59 shows some joiners' and smiths' tools taken from *Moxon's Mechanick Exercises*, published in 1678, all of which bear a remarkably close resemblance to our modern tools. Other earlier tools are illustrated at the bottom of the plate, which show still further how small has been the change in the form of various tools and implements. It would seem that the tool most fitted for its particular purpose must inevitably result from the endeavour to fulfil that purpose and that once evolved it must retain its basic form, even though slight modifications may take place. An examination of the tools used in class, and a comparison between them and such others as may be available, or of which illustrations can be procured, will furnish interesting material for discussion. A list of tools, together with their uses, might be drawn up by the scholars.

Making Tools. Quite a number of tools and implements might be made by them as shown in Plate 60, if woodwork is a class subject. Some of these will be useful in other lessons, as the needle, sewing frame, mould for tiles, mitre box, roller, and callipers. Fig. 61 shows a few more exercises of this nature. Such work is useful as it makes for independence besides giving the child

a clearer insight into the tool itself and its uses. The rule at the top of the figure, for instance, could be

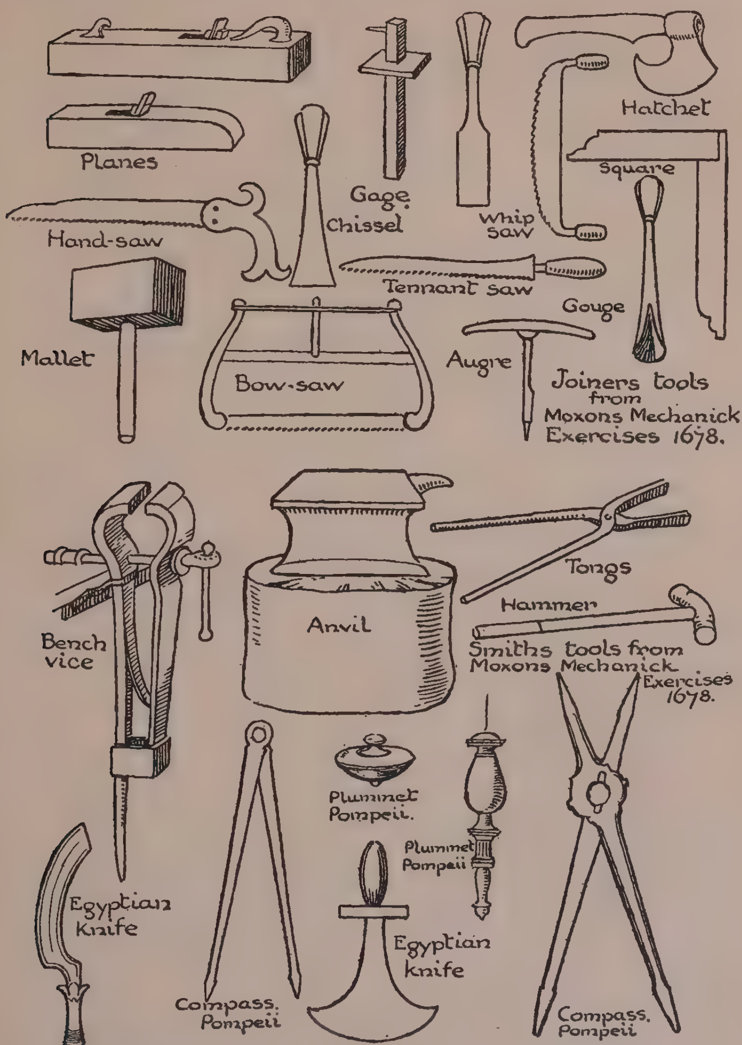


PLATE 59.

constructed without recourse to the one usually employed. A halfpenny is exactly 1 inch in diameter, and having

marked this upon a strip of paper, it can be divided into twelve, or any number of equal parts, in the manner shown. This, of course, is geometry and involves the

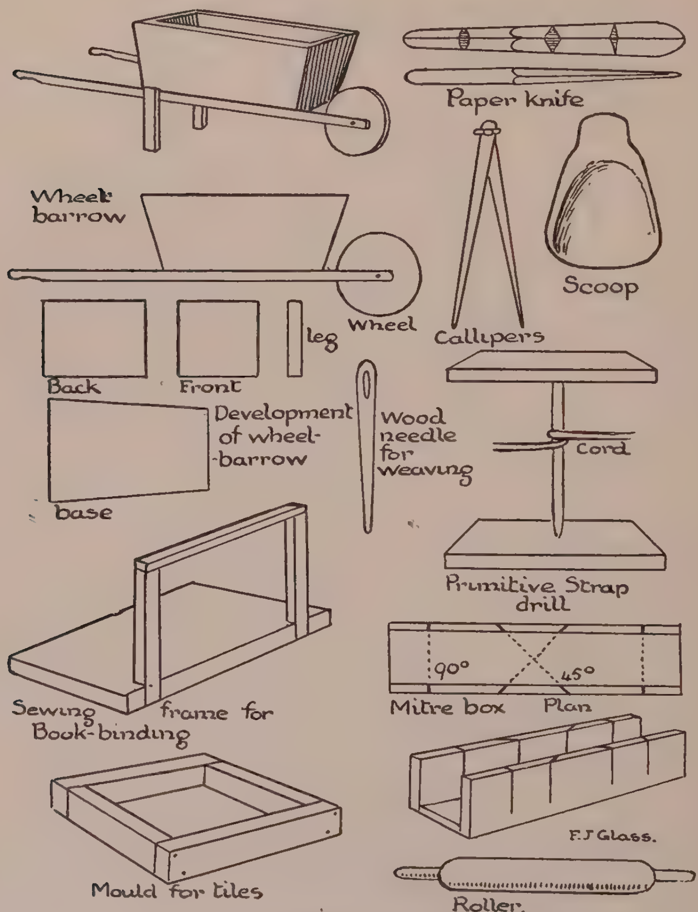


PLATE 60.

use of set-squares. The birch broom is a collection of twigs bound to a stick, and is quite serviceable for sweeping. The rake consists of some long nails driven through a strip of wood, to which a handle is fastened. The hoe is shaped from wood, again with a handle

inserted into a hole. The stone hammer might also be copied by selecting a suitable pebble, splitting the end of a stick bound previously to prevent it splitting too far, and binding the projecting ends together to keep the stone head in place. It will not be a particularly

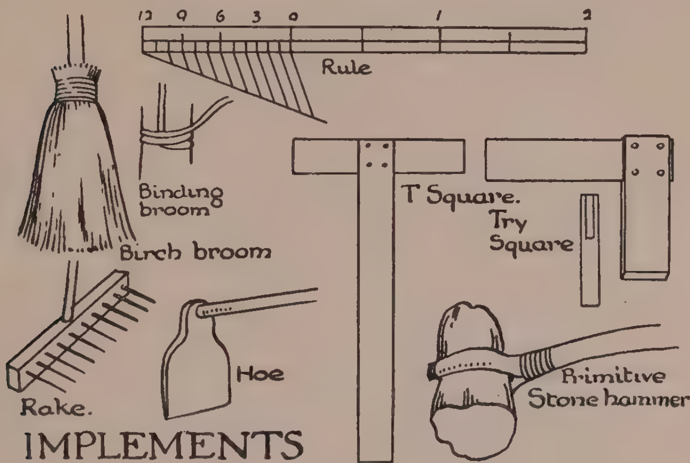


FIG. 61.

serviceable hammer but it will give the children a clear idea of the tools used by our early forefathers.

AGRICULTURAL TOOLS

Agricultural implements, and the tools employed in the production of food, will provide material for lessons. Plate 62 shows a Roman plough and an English one of much later date, proving that the basic principle remains unchanged despite the improvements in construction. Man owes much of his food to the soil, but upon his own efforts depend to a large extent the crops it yields. He must see to it that the products he needs are determined beforehand, otherwise weeds or other undesirable vegetation would spring up. Nature is prolific to a degree, but she does not always yield the food most needed by man, unless he guides her activities. He *Agricultural Tools.*

must plant the seeds of the particular cereal, vegetable, or tree, which he needs, to ensure its growth.

Exactly how or when man first discovered this fact it would be difficult to say, but we know that even during the Stone Age he was able to produce the crops he desired. Doubtless the soil was more fertile in those days, consequently it would not require such deep ploughing, or such manuring as it does to-day. Possibly he merely loosened the surface with a stick before sowing his seeds.

Plough. Perhaps the earliest plough was a tree trunk from which projected the stump of a broken limb. But upon this we can only speculate, for no agricultural implements exist belonging to these far-off days. It is presumed that the cave dwellers knew nothing of agriculture, though the lake dwellers of the neolithic age cultivated most of the cereals known to us, also peas, lentils, and the small March bean. Apples, pears, plums, sloes, cherries, strawberries, raspberries, blackberries, hazel nuts, beech nuts, acorns, etc., were also eaten by these people. Flax, too, they cultivated, for seeds have been found in abundance together with nets, woven, and plaited fabrics, manufactured from it. It is supposed that looms and shuttles, spindles and weights for stretching the thread, were used by the lake dwellers.

The ancient Scythians believed in the divine origin of the plough, so Herodotus avers, while among the early inhabitants of Germany it was thought that the ploughshare fell from heaven, and a temple marked the spot where it fell. In classic myth Ceres and Triptolemus are accredited with the invention of the plough and of agriculture, but apart from these decided myths and legends there is no tradition, no record to tell us at what epoch man commenced to till the soil. Yet the men who invented the spade and the plough are amongst the greatest benefactors of the race. Now we have steam ploughs, reapers and binders, and other mechanical devices which work with wonderful precision and rapidity.

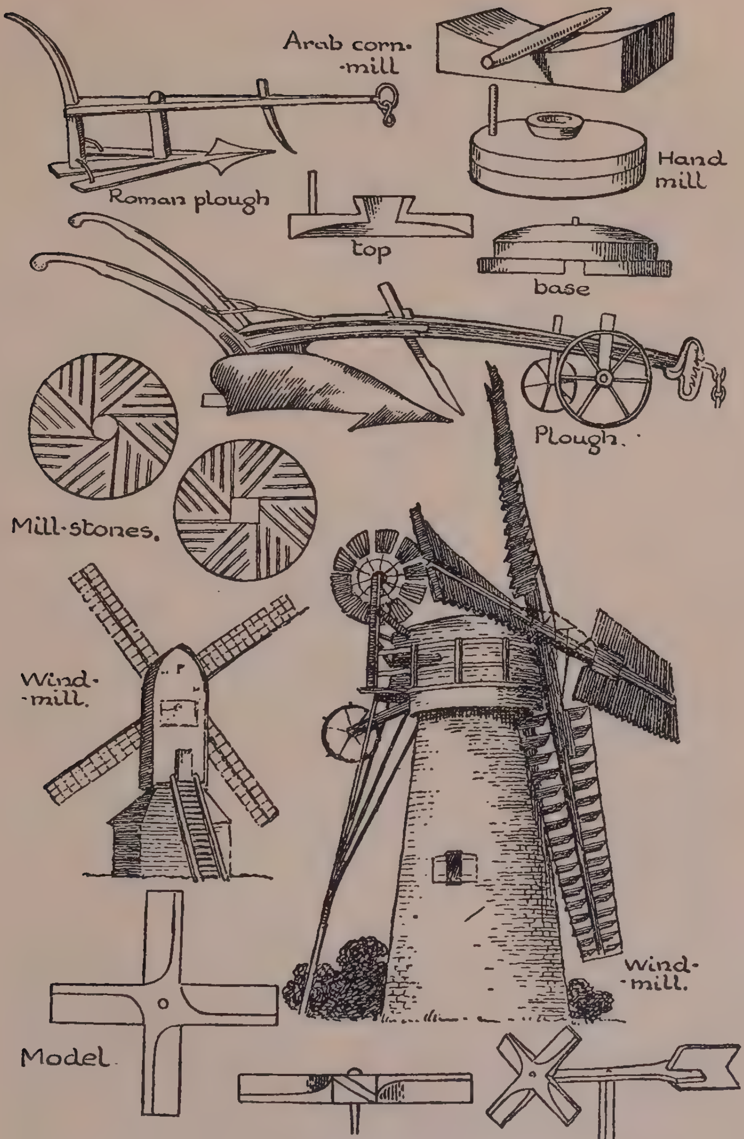

Arab corn-
-mill
Roman plough
Hand
mill
top
base
Plough.
Mill-stones.
Wind-
-mill.
Wind-
-mill.
Model.

PLATE 62.

Grinding Corn. After the sowing and the reaping, corn must be ground before it can be made into bread. Once more we return to the Stone Age, because handmills for grinding corn have been found which belong to this period, one of them at Ty-Mawr (Holyhead). Bread, too, has been found in the form of little circular cakes four or five inches in diameter by an inch or an inch and a quarter in thickness, which was baked between two red-hot stones.

Corn Mill. Plate 62 shows an Arab corn mill, a very primitive arrangement, where the grains are placed upon the larger stone and beaten or rolled with the other. The hand mill (Plate 62), in which one stone revolves upon another, with the corn between them, is one of the most ancient of mechanical contrivances. The convex form of the lower stone fits into the concavity in the upper one. The corn is poured into the central hole in the upper stone, which is rotated by means of the handle. As the one stone revolves upon the other the corn poured in at the top is ground into flour.

Wind- and Water-Mills. Then came wind-mills and water-mills, where the increased power led to the use of larger stones and more expeditious grinding. Wind-mills are very beautiful, especially when the huge sails are turning in the wind. They still exist in some parts of the country and should be visited by the children if possible. They are slowly disappearing, however, much to the regret of artists and those who delight in the picturesque.

Logical Structure of Wind-Mills. The mill provides a valuable illustration of beauty as the outcome of necessity, and of sound logical construction. The form is determined by the purpose for which the structure is erected and the conditions which govern its utility. It must be tall enough to catch the wind, strong enough to stand the heavy pull of the sails, and yet must be so constructed that the sails can be set to catch the requisite amount of wind. Further, there must be nothing to impede the sweep of those four long arms, as they swing round and round, turning the millstones which inside the building are grinding the

corn into flour. Plate 62 illustrates two of these mills. Pictures can easily be obtained, and failing a visit to an actual mill, might be used to give the scholars some idea of their beauty. The millstones are grooved as shown in the drawing, the furrows being arranged so that they cross each other like the blades of a pair of scissors. After the corn is pulverized into flour it passes out into the case by which the stones are surrounded.

Exercise. As an exercise a model of the sails might be made as suggested in the sketch. The slope of these should be noted, in order that the force of the wind acting upon the oblique planes may cause the whole to revolve.

History

Within the last century a tremendous change has taken place in the social and industrial conditions of these isles. In 1760 the typical village of middle and southern England was still an open field one, despite the fact that the enclosure of commons had been going on for centuries. The peasant holder had slowly but surely been losing his hold upon the land because of the tendency to consolidate holdings into farms of 300 or 400 acres, which was more profitable and more productive. This placed several farms into the hands of one man, and so created a class of wealthy tenant farmers, employing labourers who worked for a wage instead of living upon the produce of their own land.

Enclosure System.

Up to 1760 this movement had proceeded but slowly, and the number of enclosures was comparatively small. Then came the sudden speeding up of the enclosure movement. The advocates of this movement claimed that under the open field system, where each villager had his share of the land, the crops were poor and the methods worse. Arthur Young, a passionate supporter of the new agriculture, made tours of the country and wrote scathingly of the lassitude of the small farmers. He suggested raising the rents in order to stimulate them to industry.

Undoubtedly the enclosure of the land did improve agriculture, and increased the total yield. Waste lands were converted into arable land, while better methods were adopted generally. On the other hand it tended to impoverish the small holder, while it enriched the squires, the parsons, the lawyers, and the large tenant farmers. Small yeomen, copyholders, and tenants were ruined and gradually died out, while the labourers were either driven into the towns or remained as sweated wage earners. Previously they had been able to keep a cow or two, some chickens, geese, pigs, etc., from whence they obtained milk, eggs, cheese, butter, and bacon. Their fuel had been obtained from the common. Of all this they were deprived by the enclosure system, so that they became solely dependent upon a miserable wage. Scientific farming may have improved the productivity of the land, but it robbed a large class of men of their independence. Whole villages became depopulated, and the hopeless proletariat drifted into the mushroom towns which were springing up around the factories which the introduction of machinery had caused to be erected.

Condition of Labourers.

Strangely enough the invention of machinery to some extent coincided with the change in agricultural conditions, and gave to the current already moving in the stream of social events the force of a cataract. In 1750 most of the towns of England were small market towns still set in rural surroundings. The impetus in mechanical invention and production has gradually changed their appearance, until many of them are blackened with smoke and rendered unsightly by factories and rows of monotonous dwellings wherein reside or exist the factory hands.

Inventions.

It is interesting to trace some of the inventions which have led to this change. Hargreave's spinning jenny, Arkwright's spinning machine, worked by water power, Crompton's mule, Watts's steam engine, Jacquard's loom, etc., are but a few which paved the way for future inventions. The discovery of a new method of smelting iron

by using pit coal made great machines possible, and also enabled them to be worked economically.

Factories were in existence in the sixteenth century, but those who worked in them were hand workers. The evolution of machinery turned them into machine minders. Handicraft was superseded by great inventions and domestic industry almost ceased in the life of the people. The emphasis has for some years been upon the factory. In older days England was happy in the happiness of unborn wants, but its people have become restless and unhappy because they have learned that life holds new possibilities and amenities which as yet lie beyond their grasp.

Effect of Machinery.

The productive powers of the human unit have increased with the capacity of the machine. There are endless supplies of those necessities or luxuries which differentiate between the outward life of savage and civilized man. Some men born in hovels have become rich, while others are little better than slaves. There is less individualism and more combination. Trades Unions have sprung up and instead of bargains between workman and employer there is bargaining between groups of workmen and combines of employers. There is much unrest in the industrial world and it is one of the great problems facing us to-day to find a solution. It is no good deriding machinery. It has come to stay. The only thing we can do is to endeavour to increase the interest taken by the worker in the task he is set to do. The study of tools has led us far afield, but "any road will take you to the end of the world," and our enquiries into one subject will perforce lead us into many others. All crafts are fundamentally similar, and there will be much overlapping.

CHAPTER VIII

RECORDS

Books occupy so important—perhaps too important—a position in the education of children that the relationship they bear to ordinary daily life is almost obscured. Yet they are, after all, but the records of man's doings, the latest method of recording the things he does and the thoughts that inspire his activities.

Rock Scratchings.

Rock scratchings were the earliest attempts, followed by signs and symbols on bark, skins, wax or clay, which in due time gave place to paper rolled up, folded, or piled together sheet upon sheet. Yet unless man has known, felt, suffered, and acted, there would be nothing to record. Unless thought finds an outlet in activity it is fruitless. Hence the need for handiwork, and for enquiries into the why and wherefore, in conjunction with the study of the printed page.

Books.

Too much stress has been laid upon the page and its contents, and too little upon all that has gone to produce it, in our schemes of education. The result is that books, instead of being intimately connected with the thoughts and activities of daily life, are regarded as things apart, sometimes as mere relaxations, means of escape from the affairs and worries of the day, or, worse still, as dull, tiresome things from which in duty bound we must extract information about obscure matters of doubtful value and no interest. Books must be approached gradually, and a knowledge of their history and methods of production is calculated to stimulate a desire to learn something of their contents. As an introduction, an old book might be sacrificed and taken apart in order that its printing, decoration, sewing, and binding may be examined.

The material of which the pages are made leads to an enquiry into the manufacture of paper. Paper is made of various materials, linen and cotton rags, straw, wood pulp, hemp, jute, esparto grass, and sugar-cane refuse are all pressed into service. These are either ground to pulp as are the soft woods, or cooked as are straw and some of the hard woods, and finally bleached if necessary before being converted into paper. Rags are sorted according to the various qualities, cut into small pieces, torn into shreds, and afterwards boiled and bleached. The resulting pulp is either used alone or mixed with wood pulp according to the quality of paper required. *Paper.* *Materials Used.*

The boiling takes place in huge rotary boilers with lime or caustic soda, and occupies a period of about twelve hours. The lime or soda solution is then drawn off, and the pulp put into washers where it is washed free from any dirt, lime, or soda which remains. It is next dumped into concrete vaults with perforated floors, where it is allowed to drain perhaps for several weeks, after which it is subjected to beaters which further separate the fibres. Resin is worked into the fibres to hold them together, and such colouring matter as may be necessary is added together with a little alum. The mixture is run into chests containing water, and furnished with agitators or paddles which keep the liquid in motion and stir it thoroughly. The liquid is now run over shallow boxes based with felt, upon which settles any dirt which previous processes have failed to extract. The pulp is forced through a screen which straightens the fibres and further refines it, after which it is carried along an endless belt of woven wire which allows the water to percolate, while retaining the fibres which pass through rollers to press out the remaining moisture. Another set of heated rollers completes the drying process, while the smooth surface is produced by a further set of highly polished cylinders known as calenders. *Boiling.*

Where wood is employed for making paper it must first be reduced to pulp. This is done either by forcing *Wood Pulp.*

it into contact with a sort of grindstone or by boiling in acid or alkalis in a cylindrical tank called a "digester." The best paper is made from new rags direct from the weaving mills, while poorer grades are of wood pulp, sometimes alone and sometimes in conjunction with old rags, or other of the materials mentioned earlier.

Paper-making in Class. It is quite possible to experiment with paper-making in the class. Procure some clean linen rags and let the children tear them into small pieces and then separate the threads. This is facilitated by using a wire brush, or a strip of wood with fine nails driven through so that the points project. Dissolve some caustic soda in water and boil the threads in the solution for seven or eight hours. The next stage is to free the pulp from caustic soda by well washing in clean water. Soap is useful for further cleansing the rags. The pulp must now be made finer by snipping with scissors, after which it is soaked in a solution of starch, glue and ordinary washing blue. Stir the pulp vigorously so that it is well saturated.

A mould of very fine mesh wire netting fastened to a wooden frame, together with a separate frame called a "deckle," is now required. This is easily made in a class where woodwork is practised. A convenient size is seven inches by five, or fourteen by ten if a larger sheet is needed. The mould is dipped into the vessel containing the pulp after the contents have been well stirred; allow it to drain for a while after placing the "deckle" in place. Next lay a piece of cheese cloth at the bottom of a shallow dish perforated with small holes, and place the thin layer of pulp from the frame flat upon it. Cover with another piece of cheese cloth, and lay another sheet of pulp upon it, and so on until the required number of sheets has been reached. Lay a board upon the top and apply as much pressure as possible. A letter press, clamps, or handscrews are useful, but failing these heavy weights will serve the purpose. This process causes the superfluous moisture to drain through the holes in the base of the metal dish. When as much moisture as possible has been pressed out, the damp sheets are taken

apart, each resting upon its piece of cheese cloth, and allowed to dry.

Sizing. Prepare a size by dissolving a spoonful of clear gelatine in a cup of boiling water. Lay a sheet of paper upon the wire screen and brush over a coating of size. Lay it between two pieces of cloth and smooth with a hot flat-iron until dry, after which the cloth is removed and the dry paper ironed until a smooth surface is obtained. It is a good plan to rub the flat-iron occasionally over a sheet of fine emery cloth, some powdered pumice, or other cleansing powder in order to ensure a good polish.

An experiment of this type is calculated to give a clearer idea of paper-making than will any amount of description, however lucid it may be. The paper thus made will lack the quality and finish of much that is commonly used by the class, but it should be employed if possible in order that the children may feel that the paper they have made is real paper.

History

History. Having learned something of paper-making, a discussion might be entered upon with regard to the history and development of records. We can only speculate as to the earliest means of communication between man and man. Doubtless, signs and speech came long before anything more tangible in the form of symbols or other engraved or written forms of communication. The things they knew or thought, they told to one another and thus tradition grew from generation to generation.

Before reading and writing became prevalent, minstrels and troubadours wandered in many lands relating or singing historic and romantic songs and stories. But fortunately other records more permanent were being made, and it is to these that we owe our knowledge of bygone days. The prehistoric cave dweller scratched upon the walls of his cave, and upon ivory and bone,

records of his impressions, mainly of the animals which meant so much to him in the provision of food and clothing. Then we have cairns, monoliths, triliths, and suchlike collections of huge stones, which obviously meant a good deal to those who erected them, but of which the significance is now obscure. We can only speculate as to what they meant.

To Egypt we owe the beginnings of the symbols or forms wherwith we write or print our records to-day. At first it was a sort of picture writing, where figures, animals, birds, beetles, feathers, etc., were inscribed to suggest ideas; ideographs, in fact. Gradually these forms became conventionalized into hieroglyphic and hieratic writing, and in due course in the hands of other peoples, at other times, were simplified and reduced to the Roman alphabet, which is in use to-day.

Picture Writing.

Roman Lettering.

For many years the meaning of the inscriptions found in Egypt remained a mystery to the explorers and excavators who discovered them. Generation after generation had come and gone, and the people of Egypt had changed so much that the key to the symbols was lost. Further, the mysteries of the tombs and temples were sacred mysteries, not to be probed into lest retribution should overtake the inquisitive intruder. For centuries these tombs and temples wherein was written the thoughts, aspirations, and life stories of an ancient people, lay partly buried beneath the sand drifts, and no one cared, or dared, to investigate.

Egypt.

In the meantime the tide of civilization flowed away from Egypt, and though the forms they had initiated developed in the hands of the Grecians and the Romans into the alphabet now in use, the significance of the original forms was lost. Then came other people to whom the mysteries of Egypt were not sacred, and the treasures which had lain so long undisturbed were ruthlessly exposed to scrutiny and investigation. But the riddle remained unsolved until the discovery of the "Rosetta Stone," with its parallel inscriptions, furnished the solution, and the records of the ancient Egyptians,

Rosetta Stone.

the things they had deemed worthy of inscribing on stone or papyrus, were read by people of other nations, thousands of years later.

Even to-day fresh discoveries are being made, and the work of the ancient scribes and sculptors is telling us still more of the dwellers in the Nile valley long, long ago. We cannot help feeling some regret that their tombs should be broken into, and their labyrinthine passages explored, and also that the bodies they so carefully preserved should be ruthlessly torn from their resting-places, but at any rate these discoveries have helped us to appreciate something of the debt we owe to a bygone civilization. They help us to realize the links in the chain of evolution to which we owe our present state of civilization.

The Chaldeans and Assyrians inscribed their records on soft clay tablets, which were afterwards fired to harden and preserve them. Tablets of brass, gold, lead, and bone were also used, while in the towns of the Roman Empire the news was inscribed upon wax tablets which were posted in public places. These tablets were the prototypes of modern newspapers.

First News-papers.

Papyrus. Parch-ment.

Dried skins of animals furnished the ancient scribes with another form of material upon which to write. Then the papyrus reed was prepared by the Egyptians, and many of their records were inscribed thereon. The papyrus grew on the banks of the Nile so that Egypt had the monopoly of this, the best writing material known at the time. Parchment was discovered by the people of Pergamos because the Egyptians refused to supply them with papyrus. They steeped the skins of goats, calves and lambs in lime to remove the hair, oil, and other unnecessary matter, stretched them upon frames, and scraped them to a uniform thickness with a sharp knife. The skins were finished with chalk and pumice.

Paper.

The Chinese were the first people to make paper, from the fibres of the mulberry tree. This was about A.D. 150, while in the ninth century the Arabians discovered the

secret and made paper from vegetable fibres. Then the Moors acquired the knowledge, and from them it passed into Spain, and in due course throughout the whole continent of Europe. Its introduction into Europe coincides with the beginning of the Renaissance, and it would be difficult to say how important a part it played in that wonderful rejuvenation of thought and activity.

First Book. The first book was printed with movable type at Haarlem in the thirteenth century, and Caxton set up his printing press at Westminster in 1477. Little did the inventor of the printing press dream, as he laboured to perfect his invention, that he was putting into the hands of the race a potential force for good or ill greater perhaps than any which man has invented. It is a far cry from the simple screw press to the modern rotary machines, and many improvements have been made since the day which gave it birth, but the principle is the same throughout. Each improvement is but an addition to, or a simplifying of, the original idea of making impressions upon paper by means of pressure. The old movable type has been largely replaced by the linotype machine, a complex and wonderful contrivance, which casts the type afresh for each separate job. The old wood block or wood engraving has given place to plates produced by photo-engraving. Speed, accuracy, and cheapness have been attained, but not without a certain sacrifice of artistic charm.

Linotype. If possible the children should be taken to some printing works and allowed to see the linotype machine in use. The operator manipulates a set of keys similar to those on a typewriter, and as he taps each key a letter mould slides into position and is automatically cast in type metal, together with other letters until the width of the column is reached. The rows are slid into position to form columns. The letter moulds after being cast return to their places, ready for further use. There is an immense saving of time and labour in this method when compared with the older one of setting

up movable type. Vast numbers of separate letters were needed for each undertaking of any size, which necessitated the use of considerable space, and also much work in selecting and combining the letters needed. To-day, a small keyboard is all that is needed, at which the operator can sit, with his "copy" before him, lightly tapping the keys with his finger tips. The rest is done mechanically.

Stereo-typing. *Matrix.* The type, after being cast, is set up in formes which coincide with the size of the page to be printed, and a "matrix" is made by pressing a sort of paper pulp upon the type. When the pages are illustrated the blocks are placed in the forme along with the type before the mould or matrix is made. Where a rotary press is employed, the matrix is fitted into a special casting-box, semi-cylindrical in shape, and the molten type-metal poured in. When cool, the metal is removed, trimmed, and fastened to the rollers of the machine. The modern rotary press used for printing newspapers is a huge machine which prints, fastens the pages together, folds, and turns out the finished papers in bundles of equal numbers.

The speed with which modern newspapers are produced necessitates fine machinery, well-ordered equipment, and smooth organization. Editors, sub-editors, leader-writers, reporters, special correspondents, and occasional contributors supply the matter which is pouring continuously from the printing press for the edification, amusement, or more rarely perhaps, the demoralization of innumerable readers. There is no doubt that the Press wields tremendous power for good or ill; mainly, we trust, for good.

Illus-trations. Illustrations are used to a very large extent in the modern press. For each of these a block is required, which is usually either a zinco or a half-tone. The *Zinco Block.* zinco is used for line work, and the half-tone for photographs or other pictures which depend upon tone gradation, though wood blocks and linoleum cuts are often employed. Stereotyping makes it possible

to use any sort of relief block, except very fine ones, for newspaper work. These blocks are set up together with the type in the forme, and a matrix is made of the whole, which is then cast in half-cylindrical form to fit the rollers of the press.

A line drawing is usually reproduced by the zinco process. The drawing is placed before a special camera, which is adjusted until the image is seen upon the glass screen in its correct scale, when a negative is exposed and developed in the ordinary manner. On this negative the black lines will of course be transparent while the white spaces will be opaque. A plate of zinc is coated with gelatine sensitized with bichromate of potash. The negative is placed upon this and exposed to the light, which passes unimpeded through the transparent portions representing the black parts of the drawing, but fails to penetrate the opaque areas which stand for the white portions. The gelatine hardens under the action of the light, becoming insoluble, while the parts where no light has percolated remain soluble. The soluble gelatine is washed away leaving the hardened material adhering to the plate. In other words the drawing remains upon the zinc in lines of hardened gelatine, while the white areas are represented by clean metal. The plate is next subjected to an acid blast, or immersed in a bath of acid, which eats into the exposed metal leaving the protected parts untouched. The plate is now drilled and cleared by a skilled engraver, leaving a plate of metal with raised lines or shapes for the blacks, and depressed or clear spaces for the whites.

Sensitized Gelatine.

Printing.

When the ink roller passes over it, a film of ink is left upon the raised parts, leaving the recessed portions uninked. The printing press brings the paper into contact with the ink and forces an impression. For this purpose the metal is mounted upon a block of wood, in order to bring it level with the type, or to make it "type high," as the printer puts it. For the rotary press the block must be stereotyped or moulded in paper

pulp and recast in type-metal in order to make it fit the rollers of the printing press.

Half-Tone. For half-tone work such as photographs, or many-toned pictures, a ruled screen is interposed between the original and the negative. This screen breaks the tones up into minute dots larger or smaller according to the depth of the various tones. The rest of the process is similar to that employed for the zinco. The screen is of glass, ruled with a series of fine lines, which are incised and filled with a dense black pigment. Two sheets are employed, one with its lines placed vertically, and the other with the lines running horizontally. The result is a fine square mesh through which the light reflected from the picture passes to the negative. The size of the mesh varies according to the quality of the paper and the type of work to be produced. A very fine screen is employed for high-class book illustration and magazine work, and a coarse one for newspapers. In the latter the dots can easily be seen, but a very fine screen makes it impossible to discover them unless a magnifying glass is brought to bear upon the reproduction. The dots vary in size from 80 to 400 to the square inch. Needless to say, great accuracy is needed in the ruling and preparation of the screen. The necessity for translating pictures in tone into dots can easily be grasped if we remember that the block must be inked from a roller which leaves the greasy pigment upon any surface with which it comes in contact. Consequently it is essential to have a relief block with all printing surfaces raised to a uniform level if the whole is to be properly inked and printed.

Comparing Reproductive Processes. The children should be encouraged to compare various types of half-tone reproductions. The process is readily seen in newspaper work, but requires closer investigation in the case of better work. Half-tone and line blocks should also be compared. There can be little doubt as to which is the better method for newspaper illustration, and the children should be taught to appreciate the clean forceful line drawing as compared with the too often

hazy, almost unintelligible half-tone. Photographic processes have to a great extent supplanted the older wood engraving, but it is a positive joy to gaze upon such of the old prints as we may be fortunate enough to encounter; particularly after such a glut of half-tones. Too many of the modern illustrations are mere news items and nothing more; the wood engraving was invariably a picture as well as an illustration.

Advertising. In the modern press the advertisements are usually more artistic and easily understood than are the illustrations which represent current events. Advertising is becoming much more artistic, and not without need. In line work the artist is usually manifested, in half-tone reproductions of photographs the mechanical process is all that is revealed.

Lithography. There are other reproductive methods, each of which yields its own peculiar result. Lithography is employed mainly for posters, showcards, and other large work. As its name implies, it was originally printing from stone, but zinc has to a large extent replaced stone, owing to its comparative lightness and ease in handling. Further, it can be employed on a rotary press, while stone must needs be used on a flat bed. The modern "off-set" process introduces a rubber-faced roller as the printing surface.

Three-colour. Three-colour work necessitates the use of colour filters, by means of which each of the primaries, red, yellow, and blue, is separated from the others and photographed upon different negatives. A ruled screen is employed and a block made from each negative in the same manner as in the half-tone process. These blocks are then inked, each with its proper colour, and printed one upon another, so that the colours separated by the colour filters, and photographed upon the blocks, become reunited to produce a more or less accurate reproduction of the original.

Photogravure, Collotype, Photo-lithography, Etching, Engraving, Mezzotint, Aquatint, etc., are other methods of reproducing pictures, but space forbids more than a

mere mention. I have dealt more fully with reproductive processes in another book, *Design and Composition*.

In order to add to the interest and to give a clearer insight into the process of printing, some linoleum blocks should be cut and printed in the class. The linoleum *Lino Blocks.*

Fig. 63.

should be stout, patternless, and fairly hard. "Cork lino" is too spongy. A simple design in pure black and white is prepared with due regard for the nature of the material, and the tools to be employed. Fine lines should be avoided as they are not suited to the medium. Some suitable designs are suggested in Figs. 63 and 64. Having prepared the design with black ink on white

paper, it must be transferred to the linoleum. Note here that the block prints the design in reverse so that if it be essential that the design should appear as it is drawn, it must be reversed on to the lino. In which case a tracing is made and turned over before transferring the design to the material. If the tracing is made with black waterproof ink, and shows clearly through the paper, it may be fastened to the lino with paste, glue, or

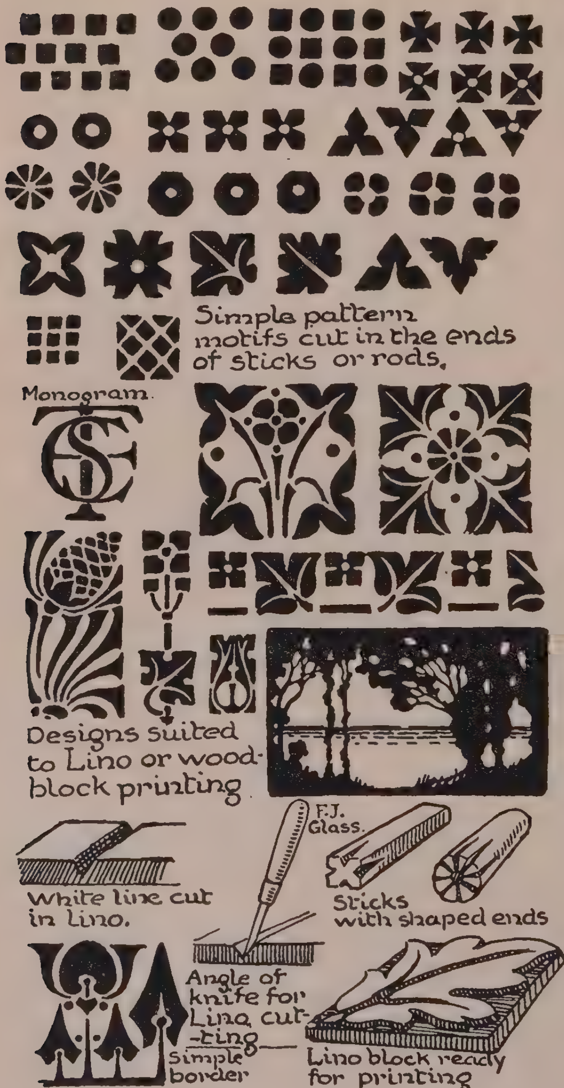


FIG. 64.

other adhesive, or it may be traced through with the

aid of carbon paper. It is a good plan to coat the surface of the linoleum with white paint before transferring the design, as it makes subsequent work much easier by defining the pattern more clearly.

When the design is upon the lino the parts which are to appear white in the print are cut away, while the black are left standing. An ordinary sharp-pointed pen- *Cutting.* knife serves very well, though a special knife, ground to a wedge-shaped point on one side only, is preferable because it cuts the material in such a manner as to leave the lines well supported. Fig. 63 shows the type of knife generally used. The lines are cut all round the design first with the knife pointing outwards and downwards away from the part which is to print. Another cut is then made on the opposite slope, which results in a V-shaped incision—see Figs. 63, 64. When the whole of the design is thus outlined the ground is cleared with suitable gouges.

The printing is quite a simple matter as it can be done *Printing.* without the aid of a press. The paper is soaked before using and laid between sheets of damp blotting paper. The colour is spread evenly over the printing surfaces with a fairly large brush. Ordinary cheap water colour in tubes works well, especially if a little rice starch is added. When the block is coloured a sheet of damp paper is carefully laid upon it, with a further dry, smooth sheet above. This dry sheet is now rubbed firmly, and evenly, with the bowl of a spoon, a knife handle, or any smooth surface which may be available. When the whole has been briskly rubbed a corner may be lifted to see the result. If the print is patchy or too pale, more colour is added, the paper lowered into place, and again rubbed. The whole print may be reinforced in this manner if precautions are taken not to move the paper out of place on the block. If a printing press is in the *Printing Press.* school the block may be printed thereon more quickly and satisfactorily. A roller, such as those used by *Roller.* photographers for mounting prints, facilitates both inking and printing. A separate roller is of course

Wood Blocks. needed for each purpose. Wood blocks are cut and printed in exactly the same manner, but wood is more difficult to cut than linoleum. Cherry, pear, apple, or kauri pine, are smooth, soft-grained woods, suitable for wood cutting.

CHAPTER IX

LETTERING, PAPER-CRAFT, ETC.

HAVING learned something of printing, some attention should be given to lettering. The class should be taught to distinguish between good and bad types. Legibility is essential in lettering and any type which, by dint of its unusual form or its elaboration, tends to become obscure, or difficult to decipher, should be condemned. By a long process of selection and elimination, the most suitable and typical forms have been evolved, while all that was adventitious has been rejected. Consequently, it is useless to attempt variations or improvements upon the accepted types. *Lettering.*

The most common and also the most beautiful of these is undoubtedly the Roman (Plate 65, Fig. 66), which we have previously seen has grown out of the picture-writing of ancient Egypt. It does not seem possible to invent a finer or more legible combination of thick and thin, curved and straight strokes, than that which goes to the make-up of good Roman lettering. The stroke of the flexible pen, combined with the more austere line of the chisel, is revealed in each letter, and the children should be taught to appreciate the essential characteristics of each letter. There has been practically no alteration in the forms of the letters since the original type was evolved by the Romans, and we still return to the Trajan column when we desire to see the purest forms. *Roman.*

All students of lettering should base their efforts on this standard type, though in due course they will probably evolve a style which is characteristic of themselves. This may at first sight seem somewhat contradictory, but after careful consideration it will be seen

that while accepting the basic forms of the letters, it yet remains possible to imbue them with individuality. *Leicester.* Leicester is a town well known for the lettering produced there, yet that lettering is invariably fine in form, and

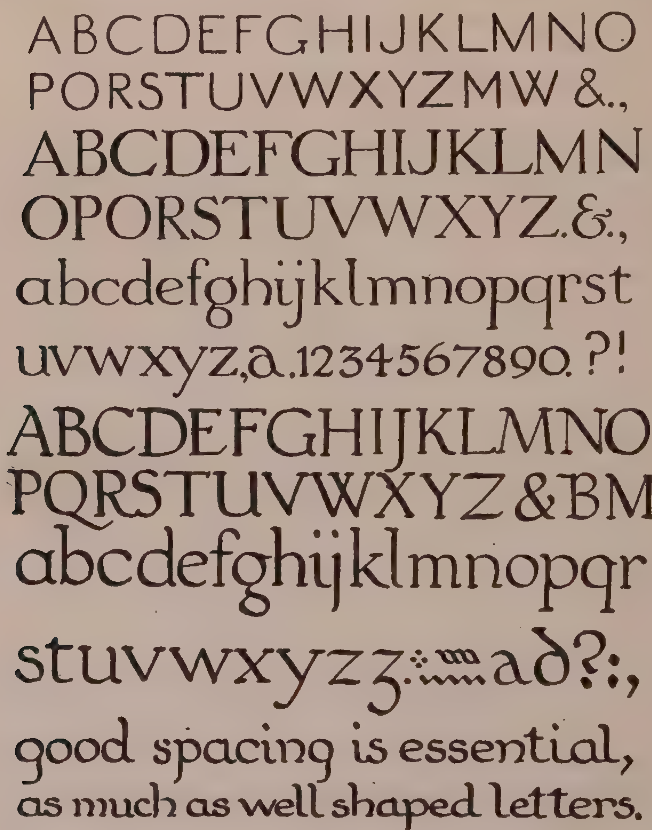


Plate 65.

excellent in spacing. There are also artists and designers whose work we can easily recognize, despite the fact that they adhere to the standard type. Originality does not consist in being new and strange, but rather in stamping our work with personality and character.

Excellent examples of lettering can easily be obtained,

and should be exhibited in the class-room. In fact, all the lettering in the school should be chosen with a view to inculcating an appreciation of good work. If the children are taught to differentiate between good and bad we may confidently look for a higher standard of lettering in the future. Many modern shop-fronts are disfigured by means of grotesque forms, or by badly spaced letters.

Perhaps the simplest forms for the children to commence with are the skeleton, or thin, uniform line letters, shown at the top of Plate 65. These might be drawn with pencil, pen, or brush, before the Roman letters are attempted. Then the pen letters, with lines thick or thin according to the direction of the stroke, should follow—Plate 65. The quill or reed pen was largely used for this purpose some years ago, but there are very useful steel pens now on the market, which save a deal of trouble in cutting and preparing. It is perhaps advisable, however, to show the pupils how to prepare a quill pen for lettering purposes, as it makes for self-reliance

FIG. 66.

Pens.

if we can produce our own implements. The method of doing this is shown in Fig. 63. In this type of lettering the forms depend entirely upon the use of the implement employed, as the pen is exploited to its full extent.

The final stage is the Roman letter, which is by no means easy to draw well. The contrast of thick and thin, curved and straight line, is wonderfully subtle, and difficult to render. The spacing, too, is important. Needless to say, a high standard cannot be expected, but if the pupils learn to produce a fairly good type of letter, and to space them at all pleasantly, they will be better able to appreciate good work when they see it.

Script Writing. There is a tendency nowadays to use script writing to a considerable extent in the schools. This is all to the good as it tends to produce legible forms and a pleasant appearance in the page.

We have now examined, somewhat cursorily it is true, printing and writing, together with the methods employed and the forms of the letters. The next stage is to enquire into the make-up of a book. We have suggested that an old book should be taken apart in order to discover how it was put together. We may now undertake a few simple exercises in book-making.

Folder. To commence with, a folder, as illustrated in the upper left-hand corner of Plate 67, will provide a suitable exercise. It is just as well to make it to serve some useful purpose, consequently it might be arranged to hold picture post-cards or such illustrations as may have been collected, to elucidate some other lessons. The pictures will determine the size of the page, which should allow for a margin of an inch or so all round. Stout paper is necessary, and a large sheet will yield a fair number of pages. Set out the size of the page in one corner of the sheet and continue the line which determines the depth across the whole sheet. Fold upon this line and cut, so that a long sheet of the desired width is obtained. Now fold up and down as indicated in the drawing (Plate 67), as often as the paper permits.

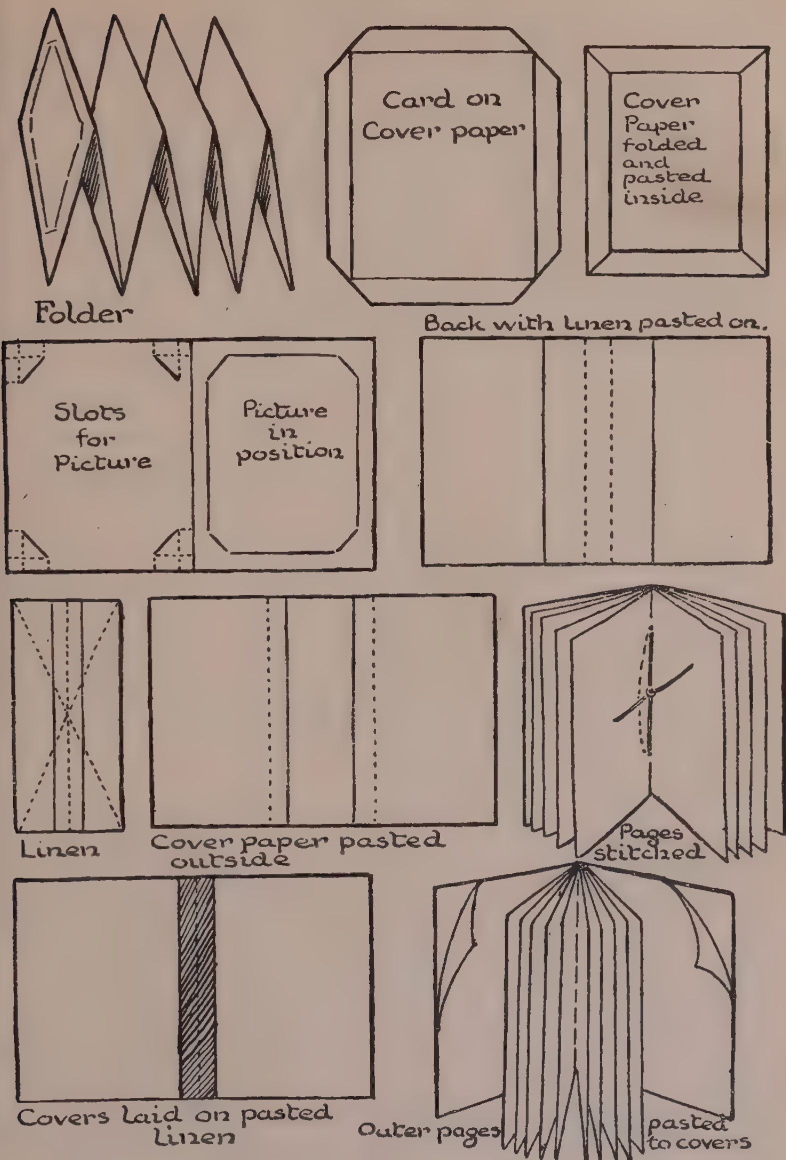

Folder
Card on Cover paper
Cover Paper folded and pasted inside
Back with linen pasted on.
Slots for Picture
Picture in position
Linen
Cover paper pasted outside
Pages stitched
Covers laid on pasted linen
Outer pages
pasted to covers

PLATE 67.

The next stage is to cut four slots across the corners, each to hold one angle of the card as shown in Plate 67. This is quite a simple task, though it requires a certain amount of accuracy and neatness to ensure uniformity in the pages and a correct fitting of the pictures. If desired, a stout card can be pasted to the two outer pages to protect the folder.

Covers. A paper cover, or book jacket, used simply to keep the binding clean, is another easy exercise. The book to be covered is opened out and laid flat upon a sheet of stout paper to determine the size. An inch or two should be allowed for turning in. Draw a line to mark the size of the paper required. Trim the corners at an angle of 45 degrees, just touching the corners of the book—see Plate 68. The back or hinge portion is cut as indicated, and the projecting pieces folded inside to give a neater, stronger edge. The book is laid upon the paper and the margins folded over and pressed down. If used simply as a protection for a bound book there will be no need to stick the paper down, as the pages will keep it in position. If, however, we are covering cardboard in order to make a cover, it will be necessary to paste the two together as shown in Plates 67, 68, which shows the neat mitre joint where the paper meets at the angles.

Portfolio. A portfolio to hold papers or drawings provides another useful exercise. For this a couple of sheets of stout cardboard or strawboard, some bookbinders' cloth, a couple of lengths of tape, some cover paper and paste are needed. The folio should be made to a useful size, so that it can be utilized for holding drawings, illustrations, or other loose sheets. Half, or quarter imperial, are good sizes, and it is advisable that each scholar should possess a folio in which to keep the work done in the drawing and design class. Having procured the materials and determined the size of the portfolio, the cards are cut to shape. Next cut a strip of bookbinding cloth, allowing an inch or so at the back, for the width of the papers which are to be placed in the

folio, and two or three inches for the portions to be pasted to the cards. Fold the cloth to find the centre or draw diagonals if preferred, and draw a line on either side equidistant from the centre to indicate the positions of the cover boards. Coat with paste the parts which will come into contact with the cards and lay the cards in place (see Plate 68); then turn the whole over and

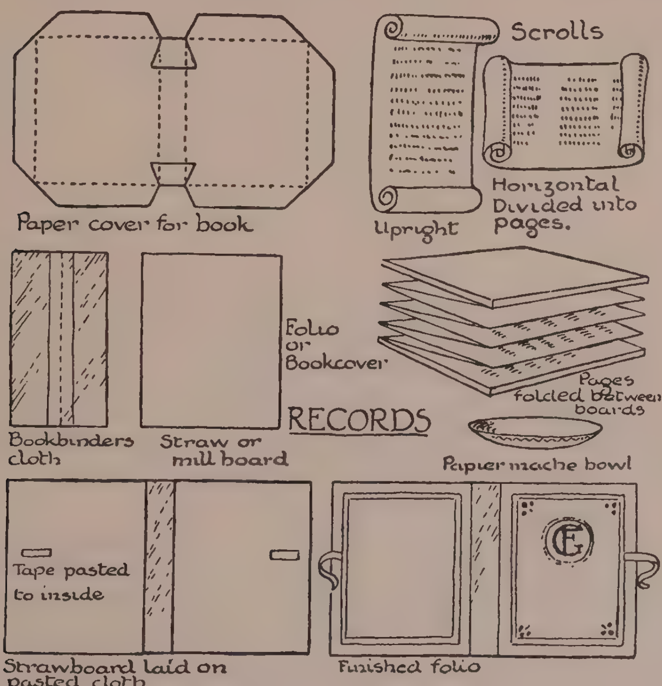


PLATE 68.

press the material into close contact with the boards. The tapes are passed through slots cut in the cards and pasted to the inside, which may be covered with paper to make it neat. The outside of the folio might be decorated with a monogram, or a simple pattern, and a border line—Plate 68. Brush work, or stencilling, are the most suitable methods for decorating the covers, and it will add considerably to the interest of the work

if the pupils are allowed to design their own monograms and decoration.

Simple Book. The next project is a nearer approach to actual book-making, as it comprises a number of pages stitched together and placed within covers. Take a number of sheets of paper of suitable size and fold them in the centre. Lay them in position one upon another and pierce three holes, one central, and one on either side. Lay a stout thread along the inside of the fold and pass the ends through the holes at top and bottom. Bring the ends back through the central hole, and tie a couple of knots to hold the inner thread in place. The covers are made in the manner described for the portfolio, and the first and last pages of book pasted to the inside of the covers. The illustrations (Plate 67) will show how this is done.

The projects dealt with are simple and well within the scope of most children. There is no space here to deal with book-binding in all its branches, as it is a big subject, and in most schools it is hardly possible to do more than touch the fringe. The aim is not to produce skilled binders, but to teach the children sufficient to enable them to appreciate books and the methods of making them—Plate 67.

Paper Experiments. They should also be encouraged to examine and to experiment with various types of paper. They should try the effects of various media upon different types of paper. Pen and ink, pencil, chalk, charcoal, and water colour, might be applied to the papers available and the effects of each noted. Some papers are absorbent, and take ink and colour very indifferently, while others, which have been properly prepared and sized, take it well. Smooth papers which have no "bite" are not suitable for charcoal, or crayon, while pencil will take upon almost any surface, though some are better than others. The methods of producing designs upon book covers, together with the tools and materials employed for the purpose, afford subject-matter for enquiry and discussion.

Paper and cardboard covers are printed from a zinco or a half-tone block, or from ordinary type. Cloth bindings are stamped with a relief block such as the zinco, in black, white, colours, or gold. Leather covers are tooled, either blind or gold, while for commercial purposes they are usually stamped with a relief block. *Printing Book-covers.*

The history of the subject opens up a wide field. *History.* We have seen how the Egyptians used papyrus for many of their records and it suggests the origin of the word paper. Scrolls were the earliest forms of manuscript, and they were rolled upon sticks or rods. *Scrolls.* The first ones rolled vertically and read from top to bottom; later they were read horizontally from end to end, and still later a sort of page form was adopted upon the horizontal scroll—Fig. 68. Then the inscription was folded as shown in Fig. 68, producing a sort of unbound book. Finally, the back edges were bound together and the book came into being.

The Romans made beautiful ivory cases for their *Romans.* double wax tablets, and those which date from the second and third centuries are exceedingly fine. The monks were perhaps the first book-makers, and the manuscripts written and illuminated in the monasteries rank among the world's treasures. Writing and decoration, richly coloured and gilded as it was, was all executed by hand. There were no reproductive processes for duplicating in those days. The *Book of Kells* in the library at Trinity College, Dublin, is a wonderfully beautiful example, and there are many others preserved in museums and libraries throughout the kingdom.

The British Museum is rich in manuscripts and book-bindings, and many profitable hours can be spent studying them. Many of these old books were bound in oak boards, sometimes covered with leather and mounted with gold, silver, or other metals and jewels. *Old Books.* They are mainly written upon parchment or vellum, which in many instances has aged a lovely soft creamy

colour. William Caxton bound his books in tooled leather, while later silk, satin, damask, velvet, and vellum, sometimes combined with jewels and precious metals, were all utilized.

Nowadays the average book is printed in large sheets which contains thirty-two pages, so arranged that when folded and cut the pages run in their proper numerical order. The sewing and binding is done by machinery. Books are distinguished according to size, dependent upon the number of times a sheet of paper is folded to produce the page. A folio is a book in which the sheet is folded once. A quarto, or 4to, is made from sheets folded twice, producing four leaves or eight pages. An octavo, or 8vo, has the sheets folded three times, producing eight sheets or sixteen pages.

It is probable that the Chinese were the first people to print. Engraved blocks were employed by them in the printing of books as long ago as the sixth century A.D. John Gutenberg began printing in Germany in 1440 or thereabout. At first he used wooden blocks, but later he cast his type in antimony and lead, producing movable type, which would be set and reset, as occasion demanded. Caxton printed the first English book at Westminster in 1477. The earliest printing was done with the aid of hand presses, where the pressure was exerted by turning a stout wooden screw by means of a bar. The copying press used in many offices for taking copies of letters is similar in its construction and action. The entire press was made of wood. Many years elapsed before the cylinder or roller was introduced for printing purposes, as it was not until 1800 that it was adopted in England. Now the roller is common enough, as the rotary press has practically displaced the flat-bed press. The linotype machine was invented in 1886.

Roller Printing.

In order to demonstrate the process of stereotyping, a cast in lead may be taken from a linoleum block which has previously been cut. The matrix or mould is made of paper pulp, several sheets of stout but porous paper soaked in water and pressed well down upon the lino

block. Allow it to dry somewhat before separating the mould from the block. Melt some lead in an iron vessel, and pour slowly over the mould. Allow the metal to cool and peel off the paper pulp. The result is a lead cast of the lino block, similar in all respects to the stereotype used for newspaper work, except that it lacks the cylindrical form, which is necessary for fitting the block to the rollers of the printing press. Despite this, however, it is near enough to give the pupils a clear idea of the process. *Exercise.*

Much more might be written upon this subject of records, in fact each of the numerous aspects so lightly touched upon here contains enough subject-matter for a whole book, but space is limited, and the ground to be covered extensive. The aim is simply to suggest a method of approach, and also some of the possibilities which lie in the various subjects touched upon. Exercises should be undertaken wherever opportunity affords, as in this manner the children will learn more about printing and records than by mere description.

Printing from Sticks.

An excellent plan for clarifying their ideas of printing is to procure some short sticks of soft close-grained wood, square, round, and triangular in section. One end should be smoothed with glass-paper. Smear some colour or ink fairly thickly upon a pad of cloth, leather, or even paper. Press the smooth end of the rod upon this and imprint it upon a sheet of paper. If the paper is previously damped it will take a better impression. After a simple square, round, or triangle has been printed a number of times, and they can be so arranged as to form patterns giving an insight into design as well as printing methods, the end of the stick should be cut to form other units of design. Fig. 64 indicates some of the possibilities which lie in this direction. The shapes are easily formed by notching, or trimming the end of the rod, with a sharp pen-knife, or by boring a hole with the point. This combined with lino or wood block cutting will help to explain the basic principle of all printing processes.

Potato. Even a potato can be utilized for printing purposes, and being easy to obtain and soft to cut is not to be despised. Further, the starchy moisture it contains makes it very suitable for the purpose. Fig. 69 shows a pattern together with the printing surface of the potato. The potato is cut cleanly into halves and the pattern cut from the flat surface of one half. The pattern illustrated will need both halves, as the leaf is cut from one and the grapes from the other. If the units are fitted into squares previously set out upon a sheet of paper an interesting pattern can be evolved.

Fig. 69.

This plan is also suitable for the decoration of textiles, as the printing surface will take up and print either water colours or suitable dyes. It must first be seen, however, that the surface is well covered with the colour or the impression will be a poor one. Needless to say, the potato must be fresh, and should be printed soon after it is cut, as if allowed to become dry it loses its firmness. Also it is somewhat soft and brittle and needs careful handling or it loses its sharpness of contour. It will probably occur to the teacher to experiment with other materials for printing purposes.

In many schools there are hektograph or similar outfits, where a pad of gelatine is employed. This could be utilized in the class to demonstrate the transfer process, used by the lithographer, who first draws his design or picture on transfer paper with lithographic ink and then lays it face downwards upon the stone. The paper is removed and the stone "etched," as it is termed, in the usual manner, the litho ink which remains upon the stone acting as a resist to the chemical action of the nitric acid used for this purpose.

Paper Work. Exercises in paper work might also be undertaken. Paper is one of the most commonly used materials, and having enquired into its composition, manufacture, and characteristics, it would be a good plan to attempt various articles in this material. From stout paper and card many things can be fashioned, while with papier mâché there are endless possibilities. Fig. 70 gives a few suggestions for work in stout paper or card. The envelope is easy to make, being dependent more upon the shape or pattern to which it is cut than anything else. A good plan is to take an envelope, steam it for a while until the gum has softened, and then open it out. After the shape has been cut it is simply folded and fastened along the edges with gum and the work is finished.

Boxes. Boxes of card are fairly easy to make. The chief difficulty lies in setting out, which needs to be accurate. This involves a use of geometric instruments, as T-square, set-squares, ruler, and compasses. In this planning, or thinking out of the article before actually attempting it, lies much of educational value. The diagrams in Fig. 70 are self-explanatory. The square box is cut entirely in one piece. The overlapping margins are to give strength to the angles, the dotted lines representing the folds. A little decoration applied afterwards in ink or water colour will improve the appearance. The cylindrical box is first drawn in elevation, i.e. the actual size, and, as it would appear if exactly in front of us, and upon the eye level. This gives an absolute rectangle, as the ellipses must be ignored in such elevation. On

either side of the first rectangle draw others, so that there are three, side by side. Leave a quarter or half an inch or so to overlap. The lid may be set out in a similar manner or included in the height of the box as desired.

Next cut two discs or circles of stout card, with a

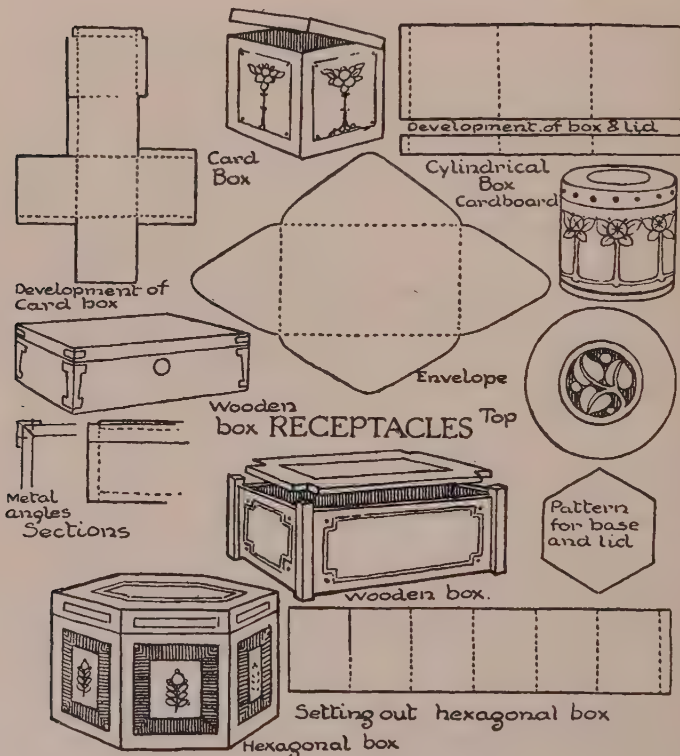


FIG. 70.

diameter equal to one of the three rectangles. Coil the card about these and paste or glue into place. A little paper pasted over the joints will make a neater job of them. Fig. 71 shows another circular box, a little less in height. This one is set out as before and two discs cut for cover and base. The card is coiled around these and fastened. It is easier to place the circular cards

inside and to put the upright card outside. When the paste is dry the lid is arranged for.

Lid. Draw a line round the box at a suitable height and with a sharp pen-knife cut through the card along this line. If the edge is at all rough, smooth with glass-paper. It now remains to fasten a rim to the inside of the box so that the lid may fit over it, and so be held in position. Cut a strip of card of suitable width and paste it to the inside, taking care that the two ends come neatly together. When dry the box may be ornamented in such a manner as fancy may dictate.

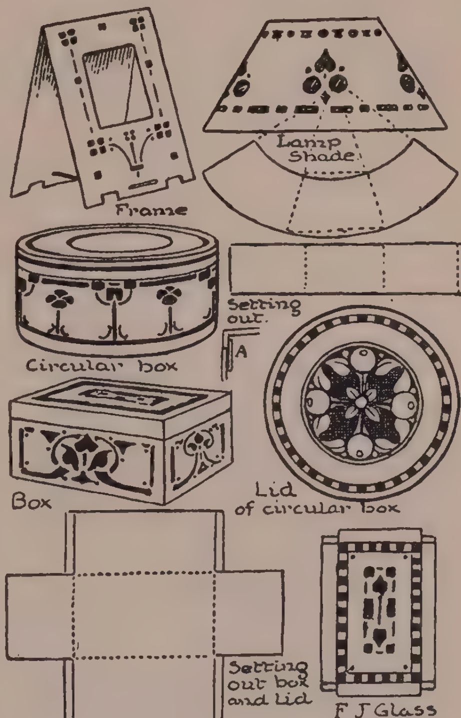


FIG. 71.

Decoration. The decoration will depend to some extent upon the skill of the pupil, and perhaps upon the work which is being done in design. Stencilling is quite suitable, ink or water colour may be employed, bands or suitable units may be cut from wall-papers, fabrics, or other patterned material and pasted to the box, or shapes may be cut from coloured paper, and fastened to the card. It is all a matter of taste and circumstance.

The hexagonal box in Fig. 70 is made in exactly the same way except that six rectangles are needed and a hexagonal top and base. Two wooden boxes are also

suggested, one with pillars at the angles which rise above the box and fit into the notched corners of the cover. The other has metal corners, which may be pewter, copper, or brass, and come easily within the scope of scholars who have done a little metalwork. Fig. 71 shows a frame or mount suitable for a post-card or other picture. No explanation is needed.

Mount.

Lamp-shade.

The conical lampshade is set out as indicated. An elevation is first drawn as indicated by the dotted lines. The sloping sides are produced until they meet, and the point of intersection gives the centre for the two arcs, which determine the upper and lower edges of the shade. Set off on either side a width equal to that of the centre and join up with the point from which the arcs were struck. This gives us the shape of the card required. Cut to shape. The next consideration is the ornament. Here again there is considerable room for choice and taste. Ink, water colour, stencil, coloured paper, etc., may all be employed as before suggested. Quite a charming method for this purpose is to cut suitable shapes from the shade, and to paste pieces of semi-transparent paper to the inner side. When the light is lit, it shines through the coloured paper with pleasing effect.

Trans-lucent Orna-ment.

Another way is to use a sort of semi-transparent oiled paper and to paint the pattern with oil colour thinned with turpentine. Here again the translucent effect is very attractive.

There are many possibilities in paper work for class instruction, and other exercises will occur to teacher and student as soon as they commence to experiment. Designs can be cut from coloured paper, and pasted to a sheet of background colour, with interesting results. Black paper on white or white on black are also capable of giving good results.

Papier Mâché

After a little work of this type has made the pupils familiar with the peculiar qualities of paper and card,

they might attempt papier mâché, which is really only a sort of plastic paper. Paper as we know it is dry, and only capable of certain things, but when soaked it becomes more tractable and can be moulded into practically any form that may be desired. For this purpose a comparatively poor quality is best, old newspapers are as good as anything. We shall need a bowl of water, some paste, a brush, and a block of hard wood for compressing the pulp, also a mould or base to work upon in the initial stages. The paste is made from ordinary flour, not self-raising, by mixing to a stiff cream with cold water, to which is added boiling water until a starchy mixture results. A little powdered alum and a drop of oil of cloves will improve the paste and help to preserve it.

Papier Mâché.

Paste.

First tear the paper into small squares of an inch or inch and a half sides and drop them gently into the bowl of water. Tear the paper instead of cutting it, as this frays the edges and obviates the danger of ridges. When enough paper has been torn and it has been allowed sufficient time to soak thoroughly, take it from the water, and squeeze out the superfluous moisture. Though the paper is thoroughly moist there should be no water floating about, or it will get between the layers and weaken the papier mâché.

Tearing Paper.

Now procure some article of metal or china of simple form to serve as a mould or base. A plaque or saucer is perhaps the best. Smear a little oil or grease over this outside or in, as the case may be, in order to prevent the paper from adhering. Now take a sheet of paper large enough to cover the whole of the surface to be worked upon and soak it in water. Lay it in position upon the mould, and with a soft sponge or pad of cotton wool press it well into contact with the surface beneath. This is to ensure a good face to the finished work and also to obviate the danger of sticking. Now brush some paste over this and remove any superfluous water. Take the torn pieces of paper one by one and lay them in position side by side in rows around the plaque or saucer, taking

care that they are placed evenly and neatly—Fig. 72. Continue in this manner until the entire surface has been treated, pressing occasionally with the hard wood in order to ensure a compact, homogeneous material. It should be borne in mind that the more pressure there is applied the harder is the papier mâché likely to be.

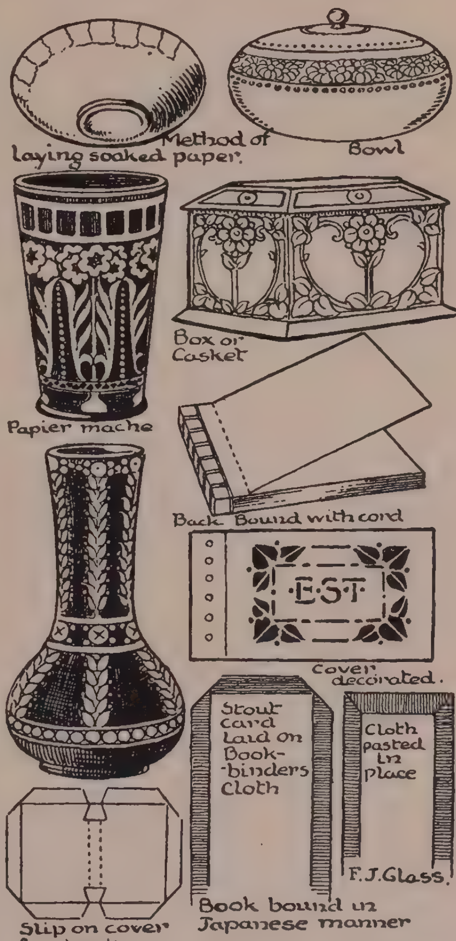
Having gone over the whole surface in this manner, another layer should be applied. There is now a danger that too much may be piled in one place, in which case the surface will be lumpy and uneven. This may be avoided by arranging the printing on the newspaper so that one layer reads the right way up, the next layer upside down, and so on throughout the work. See that sufficient paste is brushed over each layer before the next is applied and take care to keep on pressing the work as hard as possible, to ensure a hard durable substance. When sufficient paper has been applied to produce the desired thickness, the papier mâché should be left to dry somewhat. A warm dry room will materially assist in this process. When the work is sufficiently hard to stand handling the mould should be withdrawn. If this is done too soon there is a danger of the papier mâché losing its shape, whereas if left too long it may be difficult to separate the two. Once more it is left until the material has become thoroughly hard, when the edge is scraped and filed smooth and the surface evened with glass-paper.

Decoration. The final stage is the decoration. The work will first need a coating of ground colour which may be oil, or body colour, or powder colour ground into gold size, thinned with a little turpentine. When this is hard it should be smoothed with glass-paper and another coat applied. The decoration is painted on this ground in oil, body, or other suitable colour. I have dealt more fully with this subject in *Paper-Craft*, published by the London University Press.

Vases. Two other forms suitable for papier mâché are illustrated in Fig. 72, each of which, however, will be found difficult to remove from the mould when finished.

The method of procedure is exactly similar to that described above until we come to the separation of mould and papier mâché. When this stage is reached we take a sharp-pointed knife and slit the material sufficiently far to enable us to withdraw the basic form. Needless to say the moment for this operation must be chosen with care, otherwise the papier mâché will be too soft to retain its form, or too hard to bend. When the mould has been extracted the two edges are brought into contact, pasted together, and strengthened by a few applications of soaked paper. If carefully done there is no loss of strength as the result of this procedure.

The casket is built up with millboard or strawboard and strengthened with paper pulp. The hinge can be formed of a strip of leather or stout fabric. The Chinese and Japanese are skilful workers in papier mâché and a study of such articles as may be available from these



Casket.

FIG. 72.

sources will show what is possible with soaked paper. It is possible also to reduce the paper to pulp and to combine it with other ingredients such as whiting, plaster of Paris, glue, fine sawdust, etc., and to press it into moulds. Interesting relief ornaments suitable for application to articles of papier mâché or wood can be modelled in clay, moulded in plaster, and cast in such composition. This is more fully dealt with in the book mentioned above.

On the same sheet is shown a book bound in the Japanese method, where a number of sheets are placed together, with covers of stout card covered with cloth, bound together with cord. This is so arranged as to form part of the decoration of the book. Holes are bored, and the cord threaded through as shown, passing round the ends and over the back. The initials and decorative border is arranged for stencilling.

It is a huge subject, this of records, and we have only been able to touch upon the fringe of it. We hope, however, that it will stimulate the teacher to explore its ramifications, and undertake some of the possible exercises.

CHAPTER X

CLAY, POTTERY, ETC.

THERE are a number of articles in the schoolroom which may serve as an introduction to the study of ceramics. Ink-wells, cups, water-jars, or other such vessels used in the school, or the pottery used in the home, might be examined, discussed and made the start point, as it were, for a number of lessons. The purpose of the vessel, the quality, texture, glaze, and decoration (if any), should be considered and compared with that of such other articles as may be available. It should also be compared with some clay. Clay can *Clay.* easily be obtained and should certainly be introduced into these lessons. The difference between the plastic material and the fired pottery will at once strike the children and will furnish an opportunity for explaining the processes involved in the manufacture of pots.

We might first of all enquire into the material itself. What is clay? Where does it come from? How is it prepared and treated? These are a few of the questions which will arise, and to which it will be necessary to find answers. There are various kinds of clay, some grey, some yellow, some blue, and some white. Some clay is obtained in a moist form, and some dry. Clay is actually a sort of decomposed rock, known as feldspar. The decomposition is constantly in progress, while in past ages the glaciers which swept over many parts of the earth ground the rocks into fine particles. When ground, it was washed away by the water of the glacier and deposited in beds.

It is interesting to note here that the clay is generally *Clay Beds.* found in separate beds with other beds of sand and gravel

below them. The reason for this is fairly obvious when we consider the nature of the constituents of the beds. Gravel is found at the base, sand lies next, with the clay above. Gravel is coarser and heavier than sand, so that as the water flowed the gravel would be deposited first, the sand particles are somewhat lighter and would not sink quite so quickly, while the minute particles of clay would remain in suspension for some time after the water had become quiet. Hence the comparative purity of the clay. It varies considerably in quality, however, and upon its quality depends the articles which are made from it. Bricks, tiles, drain-pipes, etc., are fashioned from the coarser red or yellow clays. Terra-cotta and ceramic work used for buildings other than brick is also of a comparatively coarse nature, while pots and domestic vessels are moulded from finer clays, culminating in the fine kaolin used for porcelain.

Preparation of Clay. Clay is not often found in a pure state, it is generally combined with sand, iron, or vegetable matter, which must be eliminated before the clay is fit to use. We have seen that the fine particles of clay remain in suspension in water much longer than do the heavier particles of foreign matter. This characteristic is utilized in freeing the material from impurities. In other words it is washed free. Three operations are involved—*Washing.* washing, tempering, and pugging. The washing is done in a large tank wherein a set of paddles revolve to churn the clay into "slip" (a cream-like mixture of clay and water). The slip is run off while the heavier impurities sink to the bottom. Some clay is obtained in the form of shale, or is so hard that it needs crushing before it will mix with water. For this purpose two heavy wheels or rollers, called edge rollers, and provided with a narrow tread, are employed. These revolve in a large circular iron pan and cut and crush the shale or hard clay into powder. Clay is often exposed to the action of the weather in order to minimize the labour of crushing and grinding.

When washed, the clay is tempered or made into a paste of uniform consistency. The final process is pugging, which reduces the clay to its proper plastic condition. The pug mill is a cylinder set vertically, and containing a shaft to which is attached a series of knives which revolve. These knives cut the tempered clay which is inserted at the top of the cylinder and thoroughly mix it so that when it reaches the base to be discharged it is ready for use. Such, briefly, is the method employed in preparing clay for use.

Tempering.

Pugging.

The next stage is the conversion of the plastic material into pots or vessels. For this purpose the potter's wheel has been used from time immemorial, though to-day casting from plaster moulds is largely employed because it expedites the work, and also assists in turning out large numbers of vessels of absolute uniformity. When the potter's wheel was first used it would be impossible to say. It is clearly represented upon the walls of Thebes and the tomb of Beni-Assan, which date back some nineteen or twenty centuries before Christ. Even before this, however, pottery was made, though it is scarcely likely that the wheel or any such device was employed, for we find pots and vessels of earthenware amongst the relics of prehistoric man.

Potter's Wheel.

Prehistoric.

There are various theories as to how clay first came to be utilized for such purposes. Doubtless the plastic nature of the material would appeal to the creative instinct of these primitive people, even as it does to that of the child. The ease with which it can be fashioned into various shapes would probably induce them to model such forms as occurred to them, even as the child will attempt to fashion such things as fancy dictates. But what led to the formation of vessels for holding food, water, etc., and to the hardening of these vessels by the action of fire, we know not.

Some theorists hold that baskets, or forms woven from twigs, grasses, etc., were the forerunners of pottery. These were probably closely woven, so closely in fact as to hold water for a short period.

Woven Baskets.

Such being the case it is possible that the basket was frequently dipped into muddy water, which in due time would deposit a coating of mud or clay upon the woven strands, rendering the vessel even more watertight. It is quite easy to imagine that this would lead to smearing the vessel with clay in order to make it more serviceable. Then perhaps the clay-coated vessel, by some happy accident, got into the fire on the domestic hearth and was burned. Its owner would note that though the basket itself was reduced to ashes the clay had not only retained its form but was harder and more durable.

Other Theories. Others hold that the early potters made vessels of coiled clay in imitation of these wicker vessels and by some means or other discovered the hardening effect of fire. Another theory is that the clay was applied to fruits, which in decaying left intact the coating applied to them. The Fiji Islanders still mould their earthenware vessels round fruits. Traces of this process are found in gourd-shaped vessels, which still retain remains of the rind of this fruit. Tombs or tumuli on the banks of the Ohio river also contain fragments of pottery bearing the imprint of plaited bark, or coarse tissue in which they may have been cast or moulded. In a Peruvian tomb a basket was found designed to hold liquids, which was still capable of doing so at the time of its discovery.

Woven Baskets. The modern Chinooks weave baskets of plaited straw to contain the water in which they cook, by means of red-hot stones, the salmon which forms their staple food. There is much to be said in favour of this hypothesis that weaving baskets led to the manufacture of clay vessels, but after all, it remains but a theory.

Primitive Patterns. Suffice it to say that such vessels were made by prehistoric man, and that upon them he incised patterns of dots and strokes, which laid the foundations of decorative art. The patterns he inscribed upon his pots were added purely to gratify his æsthetic instinct. They added not one iota to the holding capacity or the strength of the vessel. From the purely utilitarian

standpoint they were a sheer waste of time and energy. But over and above his physical needs, man is conscious of others, equally insistent. "Man does not live by bread alone." The body is not all, there are other sides to the complex human entity. Spiritual, emotional, æsthetic, call it what we will, there is that desire for something higher, and more beautiful, something which transcends the solely utilitarian, and which has led to all the wonderful art and craft work by which man down through the ages has sought to gratify his desire.

Evolution of Pattern.

It is a far cry from the patterns of strokes and dots, with which the prehistoric potter adorned his plastic vessels of clay, to the elaborate and exquisitely drawn patterns which have figured on fabrics, walls, furniture, and articles of wood, metal, pottery, etc., of later periods. But we can trace the evolution more or less plainly, stage by stage, from those early beginnings. With the growth of intellect, and the increase of skill and power, it was inevitable that pattern should become more complex, more elaborate, and we believe, more beautiful, in most cases.

Pattern

Modern Pattern.

There are, however, patterns in use to-day which seem to owe their inspiration to some primitive source. Exactly what, it would be hard to say, for they are meaningless, badly drawn, feeble in form, and crude in colour, to such a degree that the most primitive work looks rich beside them. What the designers are aiming at is a puzzle difficult to solve. It may be that they cannot draw, have no sense of form, or beauty of line, or any appreciation of colour. Such a conclusion would seem more feasible than that, knowing how to draw, and possessing a capacity for line, colour, etc., they should deliberately ignore all that has been done since primeval art was born. We do not live in primitive times, and we can never recapture the phase of thought which gave birth to primitive ornament. It is surely more sensible to endeavour to take up the theme as it

has come to us from the brains and hands of long generations of artists and craftsmen who have added each their quota, than to imagine in our conceit that we can be oblivious to our heritage, and out of a sublime, studied ignorance, produce original pattern.

Children may possibly produce patterns which bear a resemblance to the early dot and stroke decoration, because the development of the individual runs parallel with that of the race. In fact their early efforts are quite likely to be of this nature, owing to the fact that muscular control is not yet perfect, nor is the brain fully developed. But as they progress, and acquire more skill with tool and material, and learn to appreciate the fine craftsmanship and design of ancient and modern times, they must needs pass beyond this stage. The wise teacher endeavours to assist them on the road to appreciation and to greater skill. But as the simple dot and stroke lies at the root of pattern design, it is a good plan to commence with it.

Dots and Strokes.

How came the early potter to evolve rhythmic pattern? Did he commence with strokes incised haphazard upon his pot, because having made it, he still felt within him the creative, or æsthetic instinct, only partially satisfied with the making of the pot? Did the strokes fall immediately into an ordered sequence, or did a few happen to so arrange themselves, and the value of such arrangement appeal to him? We shall never know. But we do know that ordered spacing, and an arrangement which evinces thought and design are better than haphazard spacing. This evidently was soon discovered by the early decorator of pots, for in most of the examples which have come down to us the decoration is orderly, well spaced, and interesting.

Order.

It has been suggested that primitive man may have conceived the idea of making pots from vessels woven of basketry, and that he may have built up his pot by coiling rolls of clay into the form he needed. The Indians made pots in this manner. They rolled the clay between the palms of their hands until they had a

Coiled Clay Pots.

long roll varying from half an inch to one or more inches in diameter according to the work in hand. Commencing at the centre of the base they coiled this round to form the bottom of the vessel, after which they placed one coil upon another to form the sides. Finally the rolls were smoothed down and pulled together so that the vessel became compact and even.

Exercise.

At this stage the class might undertake to build up a pot in this manner. In order to guide them when constructing the base, a disc of cardboard is useful. The clay is first prepared by beating it with an iron bar, adding water from time to time until it is of an even consistency. It should be soft enough to roll easily between the hands, without leaving them messy. Make some rolls of clay and place them ready for use. Take

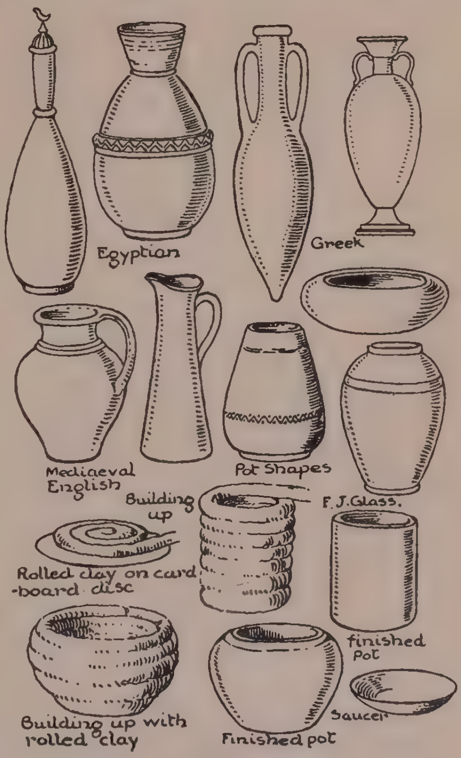


FIG. 73.

one of the rolls and coil it upon the circle of cardboard, commencing at the centre and working outwards (Fig. 73), until the edge is reached. Upon this outer edge build up the coils until a sufficient height has been attained. Now place one hand inside the pot to hold the clay in position, while the other hand smooths the face of the coiled clay. The inside may also be

pulled together at the same time. Fig. 73 shows two pots made in this manner. When finished, the work is placed aside until it becomes dry, after which it may be scraped and finally smoothed with glass-paper.

Smoothing.

This experiment will give the children an insight into the making of pottery. The next exercise might be a vase of rather more difficult shape for which a template may be used—Fig. 74. The template is a piece of card cut to the contour of the vase in such a manner as to fit to the outside of its shape. As the clay is coiled it is so placed as to coincide with the card, which is fitted against the outside from time to time.

Vase.

Potter's Wheel.

If a wheel is available it should be possible to "throw" some simple shapes to give a further insight into the process. The value of the template will be still more obvious here. Fig. 80 shows a potter at work. He takes a lump of plastic clay and throws it upon the centre of the revolving table. As the table revolves it carries the clay with it, enabling the potter with his thumbs and fingers to produce the circular form he requires. One hand fashions the inside of the vase or pot, while the other shapes the outside. If we watch him at work we shall see that every now and again he tests his form with the contour cut from the template, and makes the necessary alterations until the vessel is correct.

"Throwing."

History of Wheel.

We have seen that the origin of the potter's wheel is lost in the mists of antiquity. It was used in ancient Egypt, and also in China, the home of porcelain manufacture, from time immemorial. All peoples have made pottery and everywhere the wheel has been used. Pictures of potters at work should be shown to the class, or if possible they should be visited in order that the children may understand the methods employed.

Modern methods, however, differ considerably from those in vogue in bygone days. Vast quantities of pottery are cast from plaster moulds, and some exercises in casting will be useful at this stage. A one-piece mould is the best to begin with. Take a tumbler or some other

Casting.

tapering form which can easily be withdrawn from the mould after it is made. Make a flat slab of clay and place it upon a board. Invert the vessel to be cast, pressing its upper or open part into the clay slab until it fits down upon the board—Fig. 75. Clear the clay from the outside, leaving a disc inside to act as a stopper. Take a sheet of oiled paper and encircle the tumbler, leaving a space between sufficient to form the mould. *Walls.*

FIG. 74.

Tie this tightly with string so that it will not open when the plaster is poured inside. Press some clay around the base, and see that the seam down the side is tightly closed or the plaster will ooze out. The paper should rise a little above the base of the form within. A little oil or soap brushed over the model will obviate its removal.

Mix some plaster of Paris by allowing the powder to trickle between the fingers of both hands, held together *Plaster.*

to form a sort of scoop, into a bowl of water. When the plaster begins to appear just below the surface, stir briskly until a fairly thick cream results. Pour this gently into the space between the tumbler and the oiled paper, taking care that no air bubbles are allowed to form, and allow the plaster to set. When it is hard it should be lifted from the board, reversed, and tapped gently until the model falls out. When thoroughly dry it is ready to receive the slip or thin cream of clay and water, which is to form the casts.

Two-piece Mould. After making a one-piece mould a two-piece one might be attempted, as more complex forms can be cast in this way. First procure a suitable shape, some soft clay and four boards of convenient size. Make a bed of clay and press the vase into it until one half is embedded—Fig. 75. Now place the boards about the clay so that they enclose it as shown in Fig. 75, from which, however, one board is removed in order to illustrate the process. See that the joints are water-tight and the mouth of the vase sealed before pouring in the plaster. Mix this as previously described and pour into the space between the vase and the enclosing walls. Allow the plaster to set, take away the boards, and remove the clay from the under half of the shape. This will expose the surface of the plaster enclosing one half of the vase. Bore a hole at each corner as shown in the sketch to serve as keys when fitting the moulds together later. Brush some slip or clay water over the exposed plaster and fit the boards into place again, with the half mould below, and the exposed half of the vase uppermost. Mix another bowl of plaster and fill up the space as before. Allow time for setting, remove the boards, and separate the two halves of the mould. Take the vase away and set the moulds aside until thoroughly dry.

Pouring "Slip." Next prepare some slip by mixing clay with water until it is about the consistency of thin cream. The two-piece mould will need fitting together, which is simplified by the keys previously arranged for, and tying

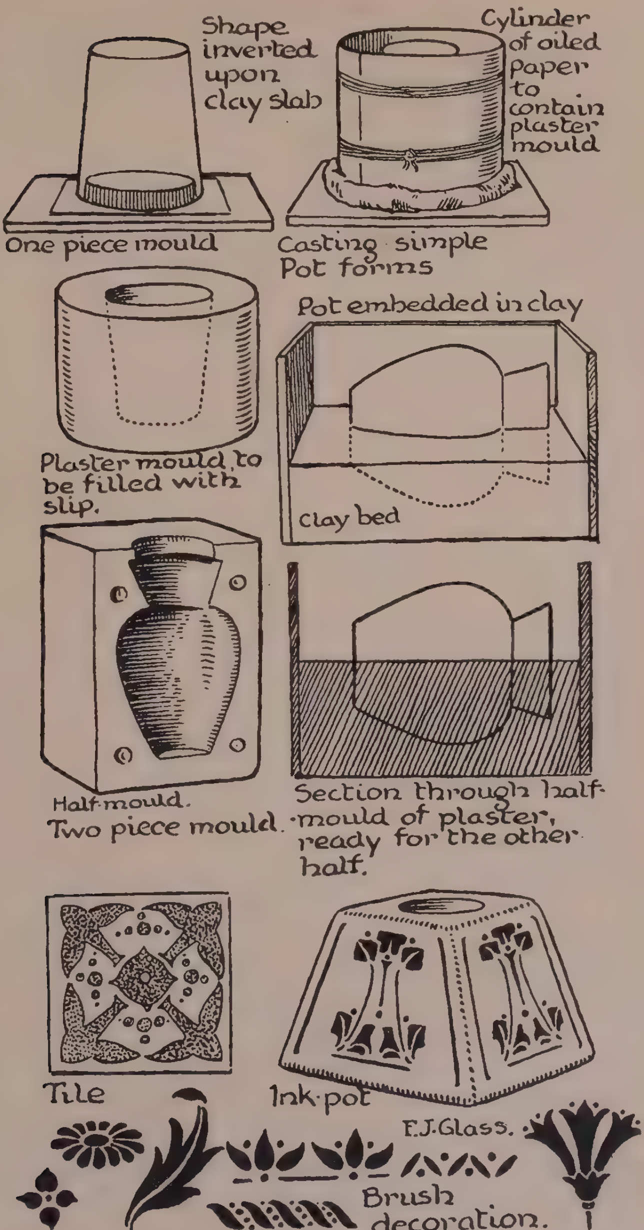

Shape inverted upon clay slab
Cylinder of oiled paper to contain plaster mould
One piece mould
Casting simple Pot forms
Pot embedded in clay
Plaster mould to be filled with slip.
clay bed
Half mould.
Two piece mould.
Section through half-mould of plaster, ready for the other half.
Tile
Ink-pot
F.J. Glass.
Brush decoration.

FIG. 75.

so that the surfaces are in close contact. The one-piece mould needs no preparation. Now pour the slip into the mould until it is quite full. The dry plaster will absorb the water rapidly, leaving a deposit of clay round the mould. As the moisture is absorbed the slip will sink. Pour in more so as to bring it level with the top again or the upper edge will be thin. By watching the edge at the top we can see when a sufficient thickness has been deposited.

Shrinkage. The clay shrinks somewhat in drying and allowance should be made for this when estimating the thickness. When we are satisfied that the deposit is thick enough the remaining slip is poured out, and the whole set aside until the clay has become sufficiently hard to handle with safety. It has been said that the material shrinks in drying. In the case of the one-piece mould the contour of the vessel will permit it to slide from the mould when it is inverted. In the other case the two portions must be separated before the vase can be withdrawn.

Decoration. The surface may now be smoothed with glass-paper and any decoration which may be considered desirable applied. Here an opportunity arises for inculcating taste and dicrimination, and for applying what has been learned of design. The decoration will depend to some extent upon the shape of the vessel. A glance at the examples shown in Figs. 73, 74, 76 and 77 will give some idea of how and where the decoration should be placed. Generally a few simple bands are sufficient, but much depends upon where those bands are placed. It will be noticed that bands are used to emphasize a break or change in the contour of the vessel. A change in the curvature is accentuated by a band of ornament, or a moulding. *Proportion.* Again, proportion plays an important part in decoration, and the bands should be arranged so that the intervals between are unequal in width. Nothing is more monotonous or uninteresting than a series of equally spaced bands.

The next consideration is the method to be employed

in the decoration of the pot. A suitable form is incised decoration, just a series of lines, strokes, and dots, scratched into the clay with a steel, bone, or other hard point, as indicated on Fig. 74. This is the form of decoration first used for pottery. It is the simplest and most natural mode of adding to the interest of clay articles, so long as they are still plastic. After they have been fired, some other form of enrichment must be adopted, as the surface is too hard to scratch. Another variety of incised decoration is to hollow out shapes from the surface of the vase and to paint the shapes with *Incised Ornaments.*

FIG. 76.

colours. Colours for decorating pottery can be obtained from various dealers. There are two varieties, underglaze, and overglaze. A little experience is necessary, as there is a tendency for the colours to change somewhat in firing. *Colour.*

An interesting variety of incised or scratched work is sgraffito. Here the vessel which has been formed of clay of a certain colour is dipped into slip of another colour, until an even coating has been deposited. Sometimes still further coatings of varied tints are applied one above another. The pattern is then scratched through the outer layer in order to expose that which *Sgraffito.*

lies beneath. Where more than one coating has been applied the lines and shapes are cut through the outer coats until the desired one is reached. Very charming effects can be obtained by this method.

Under-glaze. For underglaze painting, the vessel is first fired until it becomes quite hard, when it is known as biscuit. In schools where the actual making of the pot is impracticable, it is possible to obtain biscuitware from dealers or potteries, to be decorated by the scholars, and returned to the potteries for glazing and firing. The patterns should be thought out first upon paper in order to avoid disappointment. A flat conventional treatment is best because naturalistic designs do not repeat satisfactorily. Having prepared the design it is sketched upon the biscuit, or transferred if the form of the vessel permits it. The colours are painted on with a brush in much the same manner as ordinary water colour. After painting, the pot needs to be glazed and fired.

Treat-ment.

Glazing. The glaze, as the name implies, is a thin film of glass which is applied in the form of a paste to the surface of the biscuit, and is vitrified by heat. Glazes contain silica, which is often silver sand such as is used for making glass, to which is added lead oxide, calcium oxide, zinc oxide, alumina, clay feldspar, or other ingredients. The necessary components are ground to a fine powder and mixed with water to a thin cream. The biscuit is dipped into this and completely covered, after which it is allowed to dry, before being placed in the kiln for a final firing, which vitrifies or melts the powder, causing it to spread over the surface as a thin transparent film. This film or glaze fixes and preserves the underglaze colours, adds a fine gloss to the ware, and renders it waterproof.

Over-glaze. Overglaze painting is really an application of glaze or enamel coloured with metallic oxides or other pigments. The coloured glazes are painted on the previously glazed surface with oil of lavender. When fired, the coloured glaze is incorporated with the trans-

parent one though still maintaining its form. These glaze colours are very rich and translucent, and make beautiful decoration if applied with care and thought.

Firing. Having made our pot and decorated it by one of the foregoing methods, it is necessary to fire it. If the school has a kiln so much the better. If not, it is quite possible to fire pottery without one, and it is a good plan to carry out an experiment if only to give the children an idea of the process. *Indian Method.* The Indians have a very simple method of firing pottery. They dig a hole in the earth, and keep a fire in it until there is a large bed of hot coals. These are raked out, and the pottery arranged in the hole. The glowing embers are piled above, more fuel is added, and the fire kept replenished for a day or so. Needless to say, the pottery is often blackened with smoke, and broken by the weight of the fuel above it. There is no reason, however, why some such method should not be adopted in the school, or rather playground, in order that the children may obtain an insight into the method of firing pottery. A few old iron saucepans or kettles will serve to protect the clay articles during the firing. Place them carefully into the iron vessels and build a fire round. Keep the fire going through the day and leave untouched until everything is cool. Such experiments as this are not calculated to produce beautiful ware, they are merely intended to add to the knowledge and experience of the scholar.

Tiles. A simple tile makes an excellent exercise for children. First prepare a slab of clay six inches square. This is a standard size for tiles. The clay may be beaten out upon a board and the surface smoothed with a roller, after which the square is cut with the aid of a straight-edge and a knife. Another method is to nail four battens or strips of wood three-quarters of an inch or an inch thick to a suitable board, enclosing a six-inch square. Into the space enclosed, clay is pressed until it is level with the battens. With a strip of wood called a "striker" the clay is smoothed level with the enclosing

strips. It should be noted here that clay shrinks in drying, so that if the finished tile is to be six inches square, it should be made about half an inch larger each way.

Decoration. The flat surface of the tile offers fine scope for decoration. Sometimes tiles are modelled in delicate low relief which when glazed is very charming. Sometimes they are decorated with a pattern of raised lines known as cloisons, with glazes of varying colours floated into the spaces between. Sometimes they are formed of two- or three-coloured clays treated as a sort of inlaid pattern. In this form they are frequently employed for floorings, as the inlay extends well down into the tile. Of these different methods only the latter is perhaps suitable for the class. The modelled tile requires considerable skill, while the cloisonné tile relies upon fine drawing and a skilful manipulation of glazes. It is quite possible, however, to ornament the dried clay with lines incised with a hard point and to add underglaze colours to the shapes between, or even to cut shapes from the clay and to pour coloured slip into the spaces so obtained. Fig. 75 shows a tile which is suitable for either method, also an ink-pot modelled by hand and decorated with brush forms. A few suggestions for brush decoration are also included.

History

History. We have touched upon prehistoric pottery, and have seen that the Egyptians and Chinese "threw" their pots upon the wheel. Figs. 73 and 77 give some examples of Egyptian shapes and Figs. 73, 74 and 76 some Greek ones. These might be examined and discussed from the standpoint of suitability for purpose, and also as the outcome of the process. Grecian pottery is generally exquisite in shape and proportion, as might be expected from a people who evolved the Doric, Ionic, and Corinthian temples, and who carved the human figure with such skill and knowledge. Egyptian pots, and also Grecian, are sometimes rounded at the base, presumably they were

placed into a hole in the ground. Egyptian ware was mainly of red clay, provided by the overflow of the Nile, and in its earlier stages has little or no ornament. Later, the pots were decorated with vertical bands of colour, though later still horizontal bands were adopted as in the Greek. The usual colours were red, black, white, and brown, though about 1900 B.C. a blue glaze was employed, and about 900 B.C. a green one appeared.

Greek. Prior to the seventh century B.C. Greek vases were decorated with key patterns, meanders, and other geometric or abstract forms. After this came animals and birds, while still later came the human figure, at first black on

FIG. 77.

red, then red on black. From these vase decorations we have learned much of the life, habits, and religion of the Greeks. Many examples of these vases are in existence, because of the Greek custom of burying them with the dead. Most of our museums possess some, and if possible the children should be taken to examine those which are available.

Portland Vase. In the British Museum is the "Barberini" or "Portland" vase which was discovered in the sixteenth century within the sarcophagus enclosed in the monument of the Emperor Alexander Severus. This vase is assumed to be of Greek workmanship, but nothing is authentically known of its date or origin. It is not pure

pottery, but is composed of a dark blue semi-transparent substance like glass, upon which is modelled in delicate low relief, figures composed of an opaque white vitrified paste. This vase was copied by Josiah Wedgwood, and doubtless inspired him in the production of one of the most important branches of his work.

Etruscans. The Etruscans, a nation who occupied central Italy prior to the Romans, have left behind them many fine examples of pottery. There is a large collection in the British Museum. Generally the work bears a close resemblance to that of the Greeks, so much so that antiquarians often find some difficulty in deciding their origin. There are three varieties of Etruscan vases, some are decorated with dusky red figures, and ornament upon a yellow ground, others with black upon a reddish yellow ground, and others with reddish yellow upon a black ground. The first style is supposed to have been based upon Egyptian work, and has harpies, sphinxes, griffins, etc., while the third has gods, heroes and mythological subjects, with an intermediate or transition stage for the second style.

The following description of the mode in which he supposed these vases to have been fashioned is given by D'Harcanville somewhere about the beginning of the last century. "The clay, which is of a very fine quality, was procured from the banks of the Vulturnus, a river of Capua. Placing it in water, they allowed it to remain until it had become sufficiently pliant to be moulded into form. Then by means of the potter's wheel they shaped the clay, and while it was still wet, a coating of iron ochre was applied, which when heated at the last stage of the process produced the black colour which generally forms the ground of the vases." The painter then drew in the figures, which our writer informs us was a matter of great difficulty owing to the curvature of the surface, and to the fact that the vase must be kept upright to prevent it from falling out of shape. The borders and ornaments then appear to have been put in, and the vase placed in a furnace where the colours were burnt in and

the whole completed. There is nothing unusual about this procedure, but it is interesting because the account was written about a century ago, describing the methods supposed by the writer to have been adopted by the potter centuries before he wrote. It varies but little from all the other methods we have touched upon.

Romans. In every country where the Romans settled examples of their work is found. England is particularly rich in specimens. The earliest work is of inferior quality, as is the case with all other peoples who produced pottery. Their most notable work is the Samian ware, made of red clay, and glazed with a thin film, the constituents of which are still a mystery. *Samian Ware.* In the reign of Augustus, Arretine ware was exported from Arezzo, in Tuscany, to the Rhine, and some of it ultimately reached Britain. In the time of Tiberius, A.D. 14–37, the factories in South Gaul began to imitate Arretine ware, and between the Claudian conquest of A.D. 43 and A.D. 80 the bulk of the Samian ware imported into Britain came from these factories. During the reigns of Domitian, Nerva, and Trajan, A.D. 81 to A.D. 117, a proportion came from eastern Gaul, to which district the potters had migrated; but from the time of Hadrian to the end of the Antonine period, A.D. 117 to 192, the chief supply was from Lezoux, Puy de Dôme and other places in central Gaul. From that time to the destruction of the Gaulish industry, A.D. 260, a limited supply was forthcoming. Germany also had Samian potteries working from about the year A.D. 110 to A.D. 260.

Samian ware takes its name from the island of Samos, though the appellation is historically incorrect, as the pottery in question had nothing to do with Samos, it was produced in France and Germany. It serves very well however, to distinguish this particular type with its red, sealing-wax like colour and texture, from other types, even as the word china, though actually incorrect, serves a similar purpose to-day. The forms are generally beautiful, while the low-relief ornament or " slip " decoration is well designed and executed. The potter's name is

often stamped upon the base, which seems to prove that he was a man of some importance. Moulds were frequently employed in the production of Samian ware. There is also a black ware known as Upchurch, examples of which have been found near that place in the mudflats of the lower Medway.

Kilns. Pottery kilns have been discovered at Castor, near Peterborough, in the New Forest, at Selchester, Farnham, in Surrey, at Worcester and at Shoebury. Mr. Haywood Sumner, who excavated in the New Forest, has made a diagram illustrating the kiln in use. It represents a dome-shaped cavity or oven in which the pots are stacked in tiers. This cavity is formed of clay with earth piled above it, through which a hole is pierced as an outlet for the smoke. Below the level of the ground is a tunnel sloping upwards towards the oven, which is erected at one end. In this tunnel the fire was placed in such a manner that the wind entering the tunnel would blow the flames towards the base of the cavity containing the pots. The base itself was formed of fired clay, perforated to allow the heat to ascend to the pottery. The bulk of the smoke escaped by a narrow flue just beyond the kiln, at the end of the tunnel opposite to that from which the fire was tended. The New Forest pottery consisted of two main types—a hard reddish-brown stoneware with metallic lustre, and a softer black-coated ware, generally in the form of jugs and bottles decorated with white slip.

Glazing. Exactly how or when glazing was introduced it would be difficult to say, but it seems to have been employed from very early times. The opaque quality resulting from the use of oxide of tin seems to have been discovered by the Arabs, though it was developed in Italy and Spain. The Moors who conquered Spain brought with them the methods employed by the Saracenic potters of Cairo and Bagdad. These, combined with the methods learned by the Spaniards from their previous conquerors, the Romans, and the plentiful supply of tin in Spain led to the development of Hispano Moresque ware. In Italy

this was known as majolica, and under this name a somewhat similar ware was produced. There is an interesting theory as to the origin of the name majolica. The island of Majorca was the port from which sailed the ships which carried the Hispano Moresque ware into Italy, and the Majorcan ships led to the name majolica for the ware they transported. *Hispano Moresque.*

To return to England, after the departure of the Romans we find a falling off in the quality of the pottery. The earliest examples of Anglo-Saxon ware are mainly cinerary urns and smaller vessels, hand-made, without the aid of the potter's wheel, and are of soft ware in various shades of grey or brown, though a few are black and slightly lustrous. The cinerary urns contained the ashes of the cremated dead, while the smaller vessels probably held food and drink to refresh the departed during his or her journey to the other world. This custom dates back to prehistoric times, and was practised in many parts of the world. Altogether, this period seems to have been one of turmoil and unrest, but little calculated to develop the arts, whether of pottery or any other branch. Vessels of horn and wood seem to have almost entirely replaced pottery for holding food and drink, and we hear very little of English ware until the seventeenth century. *English Pottery.*

Staffordshire is the home of English pottery and has been so from time immemorial. It is supposed that a Roman pottery existed there, but whether pots have been produced ever since is exceedingly doubtful. *Staffordshire.*

There is a curious story current with regard to the discovery of salt-glaze, which runs as follows. A servant at a farm near Burslem was boiling a solution of common salt for the purpose of curing some meat. The salt boiled over, as such things will, and ran down the sides of the vessel, leaving a glaze upon the surface as the water evaporated. A potter in the neighbourhood, hearing of the incident, promptly made use of it and began to manufacture the common brown glazed ware. *Salt-glaze.*

Be this as it may it would seem that the development

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of salt-glazing was due to the brothers Eler, two Dutchmen who came to England in 1688 or 1690 and settled at Bradwell, where they made an improved kind of red ware which they glazed by throwing salt into the oven at a certain stage of the baking. We are told that they endeavoured to keep their processes secret, which endeavour, combined with their success, caused them to be persecuted by their neighbours to such an extent that they were compelled to depart. They did not carry their secret with them, however, for an astute fellow named Astbury, feigning to be of weak intellect, and assuming an appropriate vacuity of expression, obtained employment at the Bradwell works. Having learned the secrets of the process he promptly divulged them to other potters, who utilized them to some purpose.

This same Astbury is also accredited with the discovery of white stoneware, as the result of an incident which occurred when he was travelling to London. At Dunstable he had occasion to seek a remedy for a disorder in his horse's eyes. The ostler at the inn, whose aid he sought, reduced a flint to a fine powder by burning it, and blew the powder into the eyes of the animal. We are not told whether the remedy was efficacious, we must content ourselves with the information that Astbury, observing the beautiful whiteness of the flint after calcination, conceived the idea of applying it to his pots. So much for folk-lore, which may or may not be a correct account of these discoveries. It would seem somewhat doubtful with regard to salt glazes which were introduced by John Dwight in 1671. The discovery was made in Germany, though it is more pleasant to think that it was discovered in Staffordshire independent of the Germans.

Wedgwood. Then came Josiah Wedgwood, the greatest name in English pottery, and with him we are on firmer ground. We have seen how much he was inspired by the Portland vase of which he made a number of copies. He produced exquisite jasper wares, cameos and intaglios, and utilized the process of transferring patterns to pottery, which was

devised at this time. Altogether he did much to raise the standard of English ware generally.

Chinese Porcelain. At the beginning of the seventeenth century the jealously guarded secret of Chinese porcelain manufacture leaked out. This beautiful ware had been known in England for some time, but how it was made was a mystery. Two learned men, Scaliger and Cardan, are said to have agreed that it must have been made of a mixture of broken egg and seashells which were buried for a hundred years in preparation for the work. The exquisite quality and texture of Chinese porcelain must be their excuse for such a theory, but it proves how wide of the mark even learned men may be when they commence to theorize. The Chinese had been making porcelain for centuries before the art was discovered in Europe. Some say it was first made in the Thang dynasty, A.D. 618–907, though the Chinese claim that it was during the Han dynasty, 206 B.C. to A.D. 25. Chinese legends tell the story of pottery as early as 2600 B.C.

When the Dutch East India Company imported large quantities of Chinese and Japanese ware into Europe its influence was soon apparent in Western ware. The town of Delft became a pottery centre and gave its name to certain wares.

French Ware. The French were the first to solve the problem of soft porcelains, which was composed of sand, soda, alum, salt, and gypsum; this they made into a block and burned. The burnt material was ground into powder, made plastic, and shaped. The glazes were similarly prepared and the resultant product was of great beauty. Sèvres ware was of this type. In 1709 kaolin or china clay was discovered in Saxony, but the Saxons refused to supply the French potters who continued to make their soft porcelain until 1765, when a fortunate discovery placed kaolin in their hands. A bed of this clay was found by accident near Limoges, which in a short time became the centre of the French industry.

Japanese. The Japanese borrowed the art of pottery making from

the Chinese, but developed it in their own peculiar way. They used a great variety of colour and invented pierced and "grains of rice" ware. The famous Satsuma ware owed its origin to a group of Korean potters who formed a colony there in the sixteenth century.

Palissy. Bernard Palissy was one of the pioneers of European pottery. His ware is characterized by the rich colour of its glazes and the naturalistic modelling of the leaves, fruit, fish, serpents, etc., with which he adorned it. His life-story is one of determination and enthusiasm, which enabled him to overcome persecution, hardship, and a long series of failures. Now his work is much sought after by collectors and museums.

British Pottery. There have been many potteries in England and each has produced its own characteristic type of pottery. Chelsea, Worcester, Bristol, Bow, and other places outside Staffordshire, while the Wedgwoods, Mintons, Doultons, Carters and many others have done much for the industry. A vast quantity is turned out by the large factories, and mass production has tended to cheapen the price. On the other hand there are potters who are producing hand-made pots of considerable beauty, while a good deal is being done in schools of art.

There are many types of pottery in use in the school and in the homes of the scholars, while still more may be seen in shop windows. The children should be encouraged to note the different qualities, textures, colours, shapes, glazes and ornamentation of pots, and to compare the finer qualities with the coarser. They should be encouraged to experiment with clay, not only in the ways suggested here, but also in modelling simple forms, for in addition to learning something of the potter's craft, and of the history which is written thereon, they may also acquire a sense of form, and develop a co-operation between brain and muscle in the handling of clay.

The manufacture of earthen vessels was one of the earliest and most widespread of the industries practised by man. From the Stone Age and the days before history began to be recorded, onwards to the present

time, wherever clay was found the potter practised his craft. From every part of the inhabited globe examples of earthenware have been gathered. Most of our museums possess representative collections, and where possible these should be studied by the class. It is a wide subject with many ramifications, including as it does bricks, tiles, terra-cotta, stoneware, salt-glazed ware, porcelain of many varieties, majolica, faience, etc. There are many types and qualities grouped under the names of the makers, the classes to which they belong, or the places where they are made. Wedgwood, Doulton, Minton, Della Robbia, Sèvres, Worcester, Crown Derby, Satsuma, Belleck, Bristol, Chelsea, Samian, Willow pattern, Crackle ware, Hispano Moresque, Lustre, are just a few of the names which spring to mind.

Throwing a pot.

Fig. 80.

There is much thought content and valuable exercise for hand and brain in the subject of pottery, but enough has been said to indicate some of the possibilities which lie in it, despite the fact that we have only touched the fringe of this vast industry. The potter throwing shapes upon the wheel is always fascinating to the child, and if possible the class should be taken to see one at work—Fig. 80.

CHAPTER XI

GLASS

Ingredients. Glass is closely allied to pottery. Most pots are glazed in order to render them watertight and to enhance the beauty of the decoration and texture. Glass is manufactured in many different ways from a variety of materials of which the principal are sand or silica, soda ash, and lime. Lead is also employed and helps to produce a clear transparent type which is, however, rather softer than that made without it.

Egypt. Glass was made by the Egyptians and Phœnicians in very early days, long before the peoples of Europe had emerged from barbarism. At Thebes there are paintings of glass blowers at work, while many vessels of glass, and examples of its application to metal, as a sort of enamel, have been excavated from the tombs.

Legends. How or when it was originated is unknown, though there are some interesting legends regarding its discovery. One runs as follows. A merchant vessel laden with nitre, a form of potash alkali, was driven ashore on the coast of Palestine, near the mouth of the Belus, a small stream running from Mount Carmel into the Mediterranean. The mariners, unable to obtain stones upon which to rest their cooking vessels, used pieces of nitre instead. These, under the heat of the fire, were softened, and became incorporated with the river sand, forming a stream of liquid glass. The circumstance was noted and became known to the inhabitants of the place, who promptly set about manufacturing glass. Whether there is a substratum of truth in this legend or not it was probably by some such accident that the fusing together of sand and potash was found to produce a transparent

or semi-transparent substance. The value of such a substance would be at once apparent and would doubtless cause some inventive genius to commence experimenting. We know that the Egyptians made glass, also the Phœnicians, Greeks, and Romans, from the specimens which have been unearthed from the tombs. The Portland vase, previously mentioned, is really glassware.

Roman.

Many examples of Roman glassware have been found in Britain, for despite its brittle quality its composition is such that it resists the corrosive action of such acids as the soil may contain. In most cases it is of a bluish-green colour, though blue, olive, amber and white also occur. The British Museum possesses numerous examples which will give a clear idea of its quality. The molten material was either pressed into moulds, blown into shape, or spread flat. Some fine specimens consist of two or three layers, which were cut like a cameo, as in the case of the Portland vase and the Auldjo vase.

Anglo-Saxon.

Many examples of Anglo-Saxon glass are also to be seen which have been found at Faversham, Winchester, Fairford, Northants and Castle Eden in Durham, but where and how it was made is a mystery. All through the mediæval period glass-making seems to have been practised, though little in the way of records remain, and these are practically confined to one district. In the early days of the thirteenth century Chiddingfold in Surrey and a few neighbouring villages on the borders of Sussex and Surrey were busy with its manufacture. It is probable that many improvements were introduced from abroad, as was the case with many of the industries in those days. In the fourteenth and fifteenth centuries English glass was introduced into church windows, for we find mention of York Minster, Durham, and St. Stephens, Westminster, though it would seem that a considerable quantity was also imported.

Theophilus.

Theophilus, a monk who wrote in the twelfth century, gives a full account of glass-making and also of stained glass windows. The composition he mentions was one part of clean sand to two of beechwood ashes. This

was placed in a crucible and inserted in the floor of the furnace, which consisted of a rectangular hearth, surrounded by thick walls of clay and stone with an opening at one end for stoking the fire. This was covered in at a height of about four feet with the flat floor abovementioned, in which were the holes for the crucibles, and a vent for the escape of flames and smoke. Above was built an arched roof with windows in the front wall through which the crucibles were inserted and withdrawn. When the mixture was in a molten state, the pot was taken out, a long hollow rod or blowpipe of iron was dipped into its contents and twisted until a lump of liquid glass adhered to the end. The craftsman then blew through the rod until the glass assumed the shape of a bladder. The closed end of the bladder was softened in the flame and opened out with a piece of wood until it coincided with the width of the centre of the form. The edges of the resulting cylinder were drawn together until they met in the centre. The rod was taken from the other end and applied to this point, while the opposite end was treated in a similar manner. The cylinder was allowed to cool slowly, after which it was again heated, divided down one side with a hot iron and flattened out with a piece of wood, after which it was placed on edge in a cooling-oven.

Colour. For coloured glass metallic substances, as copper for green, protoxide of iron or of copper for red, and lapis lazuli for blue were added to the other ingredients. *Windows.* When a window was to be made the figures of the design were drawn upon a large board or table, the colours to be employed being indicated by letters. The next step was to choose the coloured glass, and to lay it in position upon the drawing. The outline was then traced upon this with chalk moistened with water. A hot iron was drawn along the outline to separate the desired shape from the rest, and the edges smoothed and finished. The necessary painting was applied and fixed by a further firing in a specially constructed furnace across which ran three or four iron bars with an iron plate resting upon

them. The painted glass was placed upon this iron slab after a layer of ashes or lime had been placed upon it, and a fire lit and tended until the flames enveloped the slab and played lightly upon the glass. The fire was then removed and the furnace closed in order that the glass might cool slowly. When cool it was taken back to the table and the various pieces laid in place. The lead was fitted around and between the various portions and finally soldered where necessary. Such is a brief account of glass work as practised in the days of Theophilus, and the difference between old and modern is not as great as one might imagine. *Leading.*

An exercise in actual glass work of this type is quite beyond the scope of most schools, but by using card, painted black, for the leads, and semi-transparent coloured paper instead of glass, it is quite possible to achieve something not unlike a stained glass window. If placed against a window so that the light is concentrated upon it, this exercise in coloured paper looks quite charming, besides assisting the children to form a clear idea of stained glass.

Modern Methods

It has been said that modern methods are not so widely separated from older ones as might be imagined. In addition to the silica, soda, ash, and lime, together with lead, already mentioned, other ingredients for colouring, such as a preparation of iron for red, of copper for green, and of cobalt for blue, are employed. The raw materials are ground to powder in a mill similar to that used for Portland cement. The powder is known as "frit." The ingredients when ground are mixed and placed in a crucible made from fire-clay, or into a large furnace pierced with openings through which the blower inserts his rod or tube. The heat required for fusing the ingredients is considerable, about 3,000 degrees Fahrenheit, and it is very trying to gaze into one of the furnaces when the contents are glowing at an intense white heat. *"Frit."*

For ordinary window glass the "metal," as it is termed, is collected on the end of an iron tube some five feet long. The end of the tube, which is thickened some-

Glass Blowing. what to gather the metal, is first heated to the temperature of the molten glass, after which it is dipped into the contents of the furnace and slowly revolved a few times before being withdrawn. The amount gathered at this first attempt will probably not be enough for the purpose. It is, therefore, allowed to cool until it stiffens somewhat, during which time the tube is revolved in order to keep the molten glass round. When cool enough it is dipped again and more material collected. Some skill is required for this work as it is necessary to keep the ball true in shape.

When the ball is sufficiently large, the blower commences to expand the molten glass by blowing. If it becomes too cool and stiff to be blown to the desired extent it is inserted into the heating furnace until it becomes plastic again. It is withdrawn and again the workman blows down the tube, swinging and revolving it all the time so that the shape may be symmetrical. Gradually a cylindrical shape is formed and finally an opening is blown through the end opposite to that which adjoins the blowpipe. The glass cylinder is laid on a wooden rack and the blowpipe removed by cracking the neck which attaches it to the cylinder. This is done by placing a cold iron against the hot glass. A thread of hot glass is wound about the ends of the cylinder and removed as soon as it has cooled into solidity. This cracks the glass and trims off the unnecessary portions of the cylinder. The cylinder will need to be cut lengthwise before it can be flattened out into sheets. This is done either with a diamond or with a hot iron followed by damping.

Window Glass. The bulk of our window glass is now blown by compressed air, which produces a more uniform thickness. When the cylinder has been cut lengthwise it is placed into a chamber where the temperature is high enough to heat the glass to a dull red colour. It then passes to another chamber sufficiently hot to soften the glass. Upon a smooth stone slab it is slowly flattened out by means of a long wooden pole, after which it is

smoothed with a wooden instrument, which passes lightly over the surface until the sheet lies quite flat upon the stone. The molten material from the furnace has thus been blown into a cylinder and finally flattened into a sheet suitable for glazing windows. It is allowed to cool gradually and slowly, which is termed annealing, after which it passes into use.

Plate Glass.

Plate-glass manufacture differs somewhat from that of ordinary sheet glass. In the first place the materials employed must be as pure as possible in order that the plate may be smooth enough to need but little grinding and polishing afterwards. The sand, soda and lime are melted and mixed in large crucibles of fire-clay. The crucible is then lifted from the furnace and taken to a roller table upon which the molten glass is poured. A heavy iron roller passes over it and reduces it to the desired thickness. It is cooled and annealed very carefully.

Grinding and Polishing.

Next comes the grinding and polishing, which take place while the plate rests upon a revolving platform which moves upon rails. The grinding is done by means of flat discs of iron and sharp sand moistened with water. When the glass is comparatively smooth a finer sand is substituted for the coarser one and the work continued, until the surface is smooth but grey, like that commonly known as ground glass, which of course it is. It is also semi-opaque, and needs to be polished before it becomes transparent. The plate is washed, and treated with rouge moistened with water, which is applied by means of a further set of rubbers formed of iron or wood faced with pads of felt. By means of these a polish is attained whereby the glass becomes clear and brilliant.

Cut Glass.

Cut glass articles are made by pressing or blowing the molten glass into an iron mould, after which the decoration is applied by means of a rapidly revolving wheel which is constantly supplied with emery powder and water.

Glass vessels are blown in a similar manner to that

Blowing Vessels. described in the preliminary stages of sheet-glass making. The glass blower dips his rod into a pot of melted glass, and takes up a small quantity on the end. This closely resembles a lump of red-hot iron and is dough-like in consistency—Fig. 78, No. 1. The workman whirls the rod round his head a few times to elongate the glass and then rolls it on a flat iron plate to make it symmetrical. He then blows through the tube until the glass at the other end assumes a globular form—Fig. 78, No. 2, and Fig. 79. He rolls it again upon the iron plate to restore its symmetry—Fig. 78, No. 3. The blowing process is proceeded with and the form expands until it is large enough to be moulded into the desired form.

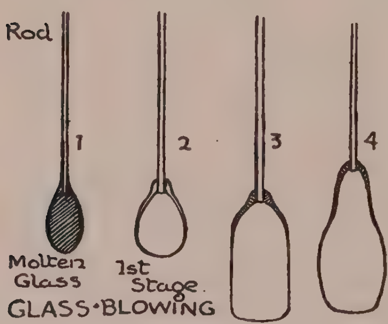


FIG. 78.

For bottles or such articles as may require to be repeated a large number of times the glass is blown into a mould, usually nowadays by compressed air, but where a few choice forms are needed the work is done by hand, or mouth. Two are needed for work of this kind; one to blow while the other shapes. With an implement shaped somewhat like sugar tongs, he compresses the form in one place, persuades the contour to take the shape he desires, bends a lip or a spout until in due course he gets what he wants. Whilst this man shapes, another blows and keeps the work revolving, so that it may not collapse or bend sideways. Needless to say, this can hardly be done with the first heating, the workman must place the glass back into the furnace from time to time.

There are many articles and vessels of glass in the school and home which might be examined and discussed by the children. It is hardly possible to carry out exercises in glass making, but if a gas flame and blow-

pipe are available the children might be shown by means of a test tube or rod how glass may be softened by heat. Another interesting experiment is to obtain a magnifying glass and to concentrate the sun's rays upon a piece of paper or such-like material until it scorches or smoulders. A further one which leads to an enquiry into colour, prismatic and pigment, is to filter the sunlight through a prism of glass in order that it falls upon the paper separated into its constituent colours. By this means they discover that white light is composed of six, or according to some theories, seven colours, so exquisitely balanced and blended that white results. Should the school possess a muffle or furnace for enamelling, some exercises in fusing glass or enamel upon copper or silver will naturally be undertaken. The grinding of the coloured glass to a fine but opaque powder, and the restoration of its translucent quality and gloss will help the scholars to grasp the change which takes place when the heat of the fire fuses the component materials into clear glass.

Exercises.

FIG. 79.

Windows will provide an interesting subject for discussion. What was used before glass was discovered, or when not obtainable? The Eskimos use ice, while the Japanese often use a semi-transparent paper. Mica is used as a substitute.

One of the most notable differences between Classic and Gothic architecture is the treatment of the windows. In the temples and even the dwelling-houses of Greece and Rome, the windows were so small and so few that

they can scarcely be regarded as a feature. On the other hand, in Gothic architecture the windows played an all-important part. A Gothic cathedral has been likened to a jewelled casket, and the simile is certainly an apt one, for the brilliant colours of the glass glowing in their delicate and intricate settings of columns, arches, carvings, and mouldings of stone, are certainly jewel-like.

Windows. In Oriental countries where the climate is warmer and clearer than in ours, the necessity for glass is not so urgent. Sometimes the window is just an opening over which projects a shady verandah to minimize the intensity of the sun's heat. Sometimes, however, a close-carved lattice is employed which though admitting the air yet excludes much of the sunlight and also prevents those outside from viewing the interior. Coloured glass is, however, often used in the houses of the richer people.

Druids. Some authorities hold that glass was made in England prior to the Roman invasion because the Druids were accustomed to impose upon the more credulous of their followers by means of clumsily formed beads of coloured glass, which they pretended were endued with the power of guarding their possessors from evil. The Venerable Bede says that in 674 the Abbot Benedict sent abroad for artists to glaze the windows of the church and monastery of Weremouth in Durham, and that these men instructed the inhabitants in the art of making window glass. Be this as it may, it was not until the eleventh century that glazed windows became at all common either in ecclesiastical or other buildings. Prior to this the window spaces were protected with linen or lattices of wood.

It was not until late in the thirteenth or early in the fourteenth century that houses were furnished with glass windows to any degree. Then, strangely enough, *Window Tax.* in 1695, a window tax was levied where houses with more than a certain number were taxed. Houses exist to-day with frames which indicate that once a window had existed there, though now the space is filled with brick or stone. Foolish as this tax was, it was not repealed

for many years, and one of the most cheering and health-giving of nature's bounties, light, was partially taken from the homes of the people. Nowadays we realize the value of sunlight and endeavour to obtain as much of it as circumstances will permit. Of late we have discovered that ordinary glass is impervious to the ultra-violet ray, a most health-giving and valuable one, and a glass which allows it to pass freely has been invented. Other changes have been brought about in the art of glass manufacture, but enough has been written on this subject.

CHAPTER XII

BASKETS, TRANSPORT, BOATS, ETC.

Baskets

Basketry in its primitive form of wattle, woven of twigs, branches, bark, and grasses, takes us back to the dawn of human intelligence and to the earliest activities of the race. We believe that the earliest shelters erected by man were woven in this manner and then coated with mud or clay. Pottery, too, is assumed to have grown out of baskets closely woven and smeared with clay to increase their capacity for holding liquids. Many primitive and uncivilized people to-day produce baskets and other receptacles woven of stems, twigs, and grasses, which are often of considerable beauty in shape, decoration, and manufacture. So closely woven are they that often they are waterproof. A coating of clay makes them quite safe. From these we may gather some idea of the baskets made by prehistoric man. There can be little doubt that basketry has been produced by all peoples in every age and clime, though owing to the perishable nature of the materials employed, the examples which remain are few and far between. Cane, willow, reed, and raffia may be employed, also pine needles if they can be procured of sufficient length. Thin strips of wood are often utilized for holding fruit and other more or less temporary purposes.

Cane is easily obtained, and some exercises in plaiting, weaving, etc., might be undertaken in the class. Fig. 81 shows some simple forms of weaving which demonstrate the principles upon which baskets are made. Figs. 82 and 83 further illustrate the methods employed.

We assume that some exercises in raffia have already been worked by the pupils from which they will have learned something of the principles involved. There is a difference, however, in the materials which is worth discovering. Raffia is so soft and pliant that very little effort is needed in its manipulation. Cane, reed, and particularly willow, are less easy to bend and to interweave.

Board. Perhaps the easiest method, and consequently the best to commence with, is to obtain a square board of some ten or twelve inches side. Having found the centre by drawing diagonals, a circle is struck of some four and a half or five and a half inches radius. On this circle a number of holes are drilled three-quarters of an

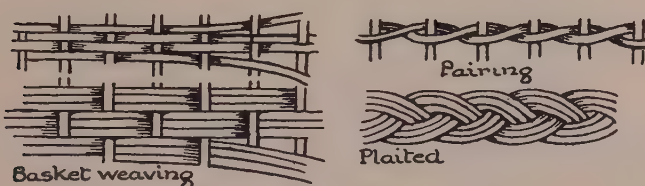


FIG. 81.

inch apart, taking care that an uneven number are bored in order that the interweaving may proceed evenly and uniformly over one and under one consistently. By means of this device the various types of weaving can be demonstrated without placing undue tax on the pupil.

Mat. When something of the process has been learned a basket may be attempted, though as a preliminary exercise a mat would perhaps be better, as it entails less skill and knowledge. Furthermore, the process is exactly similar to that employed for the basket though it is not carried quite so far. Reeds are quite suitable for this purpose. Take a number of reeds, eight will do very well to start with, and arrange them so that their centres coincide, while the reeds radiate from this centre like the spokes of a wheel. In order that they

Splitting Reeds. may hold together four of these reeds are passed through the other four, which are split in the centre to allow the others to pass through—Fig. 82. Find the centres of the

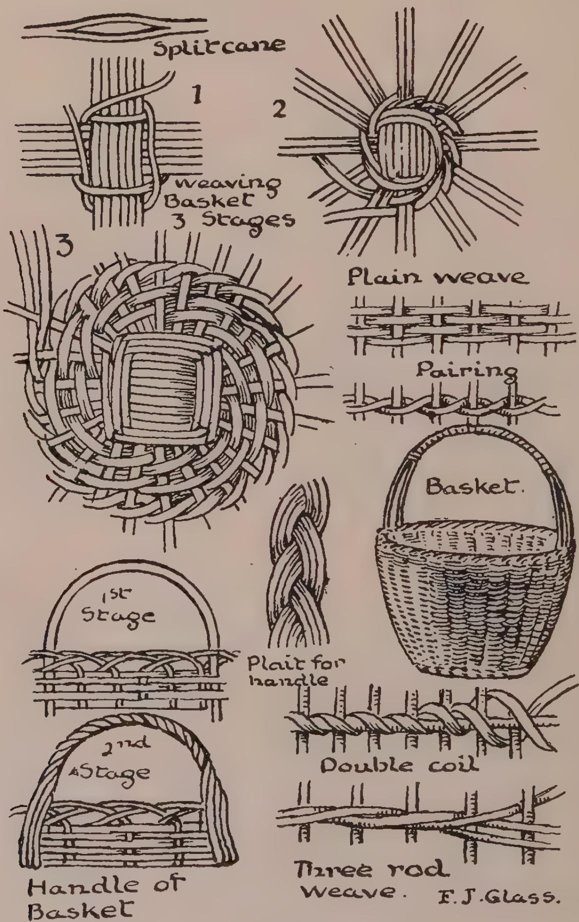


FIG. 82.

four reeds and with a stout needle or the point of a sharp pen-knife pierce a slot long enough to take the other four. Slip these through the slots until the centres of all are coincident. This makes a sort of cross. Now

take another reed half the length of the others and insert it between the others in order to secure an uneven number of spokes. Bind these together as shown in Figs. 82 and 83, and then open out the spokes so that they radiate from the centre with equal spaces between. *Binding.*

Now interlace the weaver over and under each spoke in turn, taking care that the spokes are in their proper places as the weaver adjusts itself to the spoke, and not the spoke to the weaver. If this precaution is neglected,

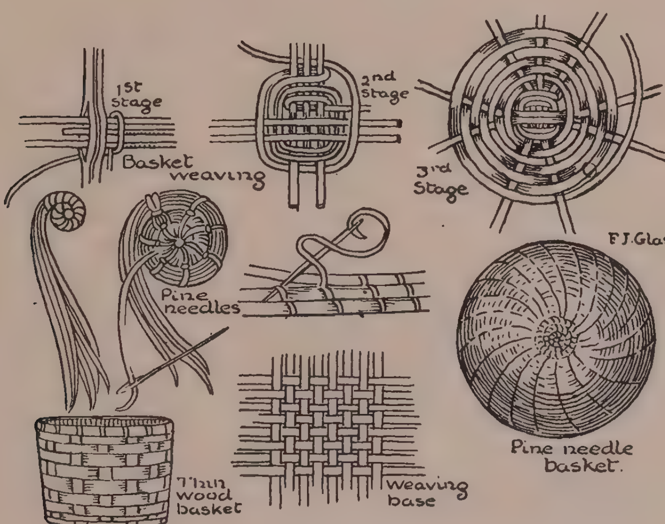


FIG. 83.

the result will be uneven, and the mat poor in form. When the mat is sufficiently large the edge is overcast, which means that the weaver is taken under a spoke, over the previous band of weaving and the next spoke to be inserted between the weaving, under the next spoke, and up again over the next spoke, down through the weaving again below the next spoke and so on. When a whole round has been completed the edge is compact and secure. *Finishing Edge.*

A basket is woven in much the same manner except that when the base is woven sufficiently large the spokes *Basket.*

are bent upwards and the weaving continued until the top is reached. The methods which may be employed for weaving the basket are fairly numerous, some of *Weaving.* which are shown in Figs. 81 and 82, which shows the plain weave, three-rod weave, double coil, etc. When the top is reached and has been overcast as above described, the handle is inserted. It may be plaited, or twisted and inserted as shown in Fig. 82. We cannot expect to produce experts in the class even if it were desirable to do so; all we can hope for is to give the children an insight into, and an added appreciation of the art of basket making.

Pine Needles. Pine needles bound with raffia can be utilized for this purpose if the needles can be obtained of sufficient length to make it worth while. The advantage of this lies in utilizing the materials which nature provides and by so doing proving to the class how man has taken advantage of the materials which lay at hand. It has not always been so easy to obtain the things needed as it is in these days of cheap and rapid transport. It is true that necessity is the mother of invention, and by using the materials gathered upon an excursion into the country, the pupils will realize the value of searching for such things, and also how much has been pressed into service which otherwise might have been neglected.

The needles should be selected so that those which are sufficiently long may be retained, while the rest are discarded, as it becomes very tedious working with short ones. The needles are arranged in groups of varying numbers according to the work in hand, and are bound with raffia as shown in Fig. 83. For a basket or mat the groups are coiled and bound together as indicated.

Wood Baskets. Strips of thin wood may be also pressed into service, and the interlacing of the strips will provide an interesting exercise. If the wood is not available stout paper can be utilized in exactly the same way. After all, the object in view is to give the class an insight into methods and materials rather than to teach them to produce

perfect baskets. It is doubtful whether it is possible or desirable to do more than deal with basic principles in the average school. Where it is desired to carry the exercises further, books can be obtained from Batsfords, or the Dryad Handifcrafts, which go more fully into the subject. *Books.*

A collection of baskets of home and foreign weave should not be beyond the resource of any school. These should be examined and discussed with regard for their purpose and manufacture, and the pupils will probably be astonished at the possibilities for the production of pattern which exist in basketry. A list of baskets and articles woven from cane, reed, and willow, might be drawn up and their purposes discussed. These are far more numerous than would appear to be the case at a superficial glance. The work of various peoples in this sphere, together with the history of the subject, will furnish an interesting topic. The materials employed, together with the manner of their growth and preparation for use, is another aspect of this interesting subject.

Transport, Boats, Etc.

Transport is a subject which is worthy of consideration, as it embraces vehicles of all types; carts, chariots, barrows, coaches, etc.; locomotives, automobiles, ships, aeroplanes, and the other inventions which have grown out of the needs of transport; while its study leads us to the ends of the world, and the beginnings of the race.

What man used for transporting loads in the earliest days it would be difficult to say. Probably some form of sledge, or arrangement of branches to act as runners, *Sledges.* which could be drawn easily over the ground while supporting a load, would have been the earliest form. It is also probable that reindeer were the first draught animals. But this is pure speculation, as our first actual acquaintance with means of transport is in connection with ancient Egypt, where chariots drawn by horses and ox-drawn carts are represented in the paintings and

carvings which have been excavated. The huge blocks of stone used for the Pyramids and other colossal structures were floated down the Nile on rafts and then dragged into position by slaves, vast numbers of whom forced the blocks over banks of earth sloping gently upwards to the required altitude, as previously mentioned.

Rafts on the Nile.

Chariots, Carts, etc.

Vehicles such as chariots and carts were also known to the Babylonians, Assyrians, Phœnicians, Greeks, and Romans, and were probably in use throughout the ancient world. In England we read of Boadicea haranguing the Iceni from her chariot of war, and all down through the ages we find evidences of wheeled vehicles.

Wheels.

Who was the first man to conceive the idea of using the disc or wheel for carrying loads? We shall never know, neither shall we know whether the form sprang straight into use or was evolved by degrees from other forms. To the modern mind the advantage of the circle over all other forms, because the circumference is always equidistant from the centre, is so self-evident that we cannot conceive of any other being used. But it does not follow that the idea would spring full blown into the mind of the first maker of vehicles. It is quite possible that he tried others before lighting upon the circle. Speculation again, however. Having discovered wheeled vehicles, it is quite conceivable that man promptly adopted them, and the invention or discovery spread by degrees over the known world, leading to all sorts of carts, carriages, chariots, etc., as different ages and different peoples adapted the idea to their own needs.

Sedan Chairs.

Sedan chairs would seem to have been a return to earlier methods, and the use of such a mode of conveyance is difficult to understand, unless the condition of the roads made them more comfortable than conveyances supported upon wheels.

Steam.

With the introduction of steam came a revolution in modes of transport, and a journey which previously had occupied days, or even weeks, became a matter of hours.

Railways. Motors.

The growth and spread of railway systems, the introduction and rapid improvement of motor-cars, and the conquest of the air, all provide interesting matter for discussion. A collection of pictures of vehicles, locomotives, motor-cars, and aeroplanes, classified and dated, would add considerably to the value of the lesson. It should also be possible to construct models of some of these things, in order that they may become more concrete and tangible in the minds of the children.

Ships, Boats, etc.

Boats, ships, and vessels for water transport are always fascinating to the child, especially the British, as it belongs to a nation which is essentially a seafaring one. Most children love boats, and every normal boy desires to possess one or more. There is no reason why this desire should not be gratified, and also turned to advantage educationally. It should be possible in most schools to make a model of a boat, a punt, a barge, a canoe, or other simple form, and the making will add to the interest and value of the lesson. If it cannot be made of wood, it might be fashioned from card or paper. Whatever the material may be, it will help to impress upon the child the nature of the vessel.

There are few things which man has evolved to serve his needs so beautiful as a boat. It is graceful in form, and fine in construction, and both have been dictated by the purpose it serves, and the elements it employs in the service of man. It floats upon the water, and is capable of being propelled through it. The rowing boat makes use of the resisting power of the water itself for this purpose, while the sailing boat employs the wind. Steam and oil-driven boats also make use of the water, which by offering resistance to the propellor, drives the boat forward. The lines of the boat are such that they offer the least resistance to the forward movement, while the water displaced is sufficient to keep it afloat on an even keel. It is remarkable that steel, which is heavier than water, can be so used as to float in masses weighing hundreds of tons.

Once more the origin of the craft is lost in the mists

Origin of Boats. of antiquity. We can only imagine some primitive savage, finding that trees would float, ventured to embark upon one as it lay in the water. What was the next stage? Did he hollow out the log and shape it externally in order that he might sail more securely, and manage it more easily, or did he construct a coracle

FIG. 84.

of branches and skins, or bark? Again, we do not know; but it is fairly certain that man discovered the means of navigation quite early.

The lake-dwellers must have possessed some means of passing from place to place over the water, above which they erected their dwellings. *Nile Boats.* The Egyptians we know traversed the Nile in boats, while they also figured

in their religious observances, for the "boat of the dead" conveyed the soul of the departed over the river to the

Fig. 85.

Osirian kingdom to face the King of the Dead, and Judge of All, Osiris. The Phœnicians were seafarers, and, we

are told, they travelled as far as these isles to trade in tin and other metals with the ancient Britons. The *Greeks.* Greeks, too, were a maritime people who built trading ships and vessels of war. These had sails, but relied more upon oars, which projected from the sides of the boat in rows or tiers one above the other, and the vessel was named according to the number of tiers of oars it possessed, as biremes, triremes, quadriremes, etc.

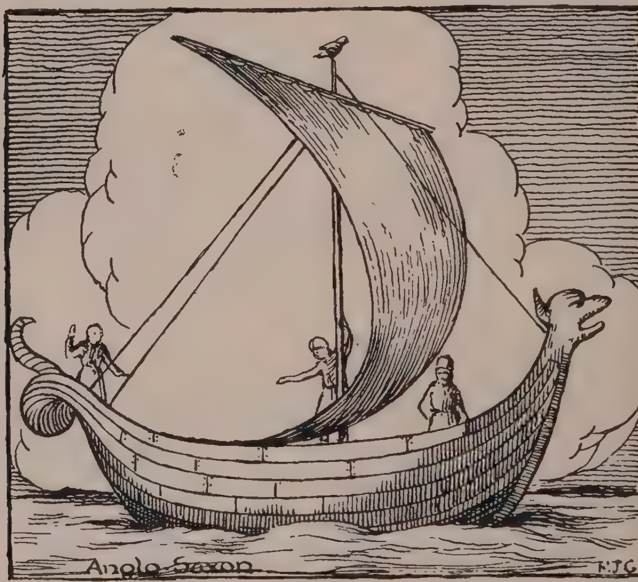


FIG. 86.

Romans. The Romans (Fig. 84), travelled all over the then known world, bent upon domination and conquest. They came in their galleys to Britain, subdued the native people, and ruled for a number of years, leaving behind them walls, roads, and many examples of their handicrafts. *Venetians.* The Venetians were a sea-going people who had ships on many waters. *Spaniards.* The Spaniards made a bid for supremacy at sea, which was wrested from them by Drake, Frobisher, Hawkins, Raleigh, Grenville and other great Elizabethans —Fig. 85.

From the time when the Britons first made coracles, and ventured upon fishing expeditions, to the present day is a long, absorbing story of seafaring. We read of Alfred the Great gathering a fleet of ships to meet the marauding Northmen, in order to prevent their robbing and laying waste the lands adjoining the coast, and in so doing he laid the foundation of the British Navy. Boats of every period since Alfred's time can be studied from pictures or from models in our museums. Figs. 84, 85, 86, 87, 88 show five examples of early ships. They have passed through many phases in the process of evolution from small to large, and from few and simple, to many

British Navy.

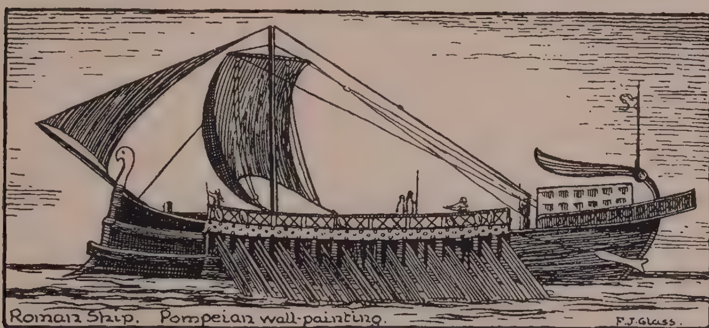


FIG. 87.

and complex sails, masts, yards, etc., until nowadays mechanism has almost entirely displaced wind and sail as a means of propulsion. The old "wind-jammer" is nearly gone and voyages take far less time than in bygone days. No longer does the ship depend upon favourable winds for a speedy voyage, she can now drive in the face of adverse ones, at a scarcely diminished speed.

The story of marine transport and the development of shipping is one of absorbing interest, but others have dealt with it and space forbids more than a mere mention here. It is worthy of notice, however, and might well be pursued by the teacher aiming at the inculcation of a knowledge of geography and of human progress, as recorded in the works of man.

Boats of Foreign Peoples. The ships and boats of foreign peoples is another fascinating branch of this subject. The "dahabeah"

FIG. 88.

or Nile boat, the "budgrow," and "dinghee," which navigate the Ganges, the "junks" (Fig. 89) and "sam-

pans" of the Chinese, the "canoes" of the North American Indians, the Eskimo boats made of a framework of wood covered with skins. The beautiful "gondolas" of Venice, the "felucca" of the Moors, and the Mediterranean "polucca," are all distinctive

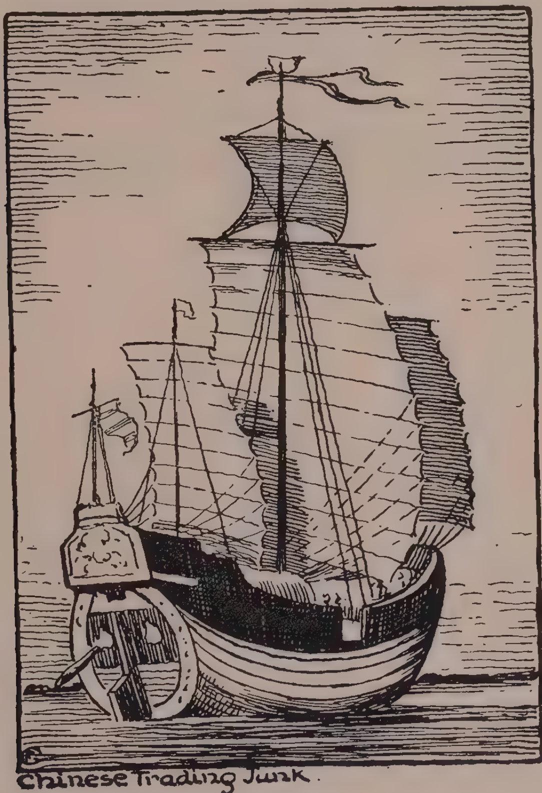


FIG. 89.

in shape and yet are designed to float and to progress through the water propelled by sails or oars. We have said that many of these are being replaced by steamships, but pictures can easily be obtained and should be studied and discussed in the class. The controlling lines, and the basic shape, are more or less similar in all, yet in each

may be seen the racial characteristics of the people who are responsible for their evolution.

Beauty of Boats. It would be difficult to find any branch of handicraft which has produced so many beautiful variations of a few basic forms, which forms have been predetermined by the purpose they are intended to serve as the craft of the boat-builder. A fishing-boat, a barge, a dinghy or any other boat, either afloat or lying upon the beach awaiting the incoming tide, is a delightful object to anyone who can appreciate its beauty of line and shape. The children should be encouraged to study them when, during their holidays, they visit the seaside.

CHAPTER XIII

DESIGN

PROBLEMS of design are constantly arising, as it plays some part, however small, in practically every exercise. The design or planning of the object itself, in its entirety, as a complete whole, must of necessity be the primary consideration, but many objects are improved by a little decoration. This decoration involves pattern design. There are numerous methods of approach to this subject, and the teacher must decide which is the most suitable for himself and for the class. The first thing to do, however, is to disabuse the mind of the child of any preconceived idea that it may possess with regard to its difficulty.

Methods of Approach.

Unfortunately most pupils, and too many teachers, labour under the delusion that design calls for unusual skill and originality. This probably arises from the idea that in design it is necessary to produce something quite new, and quite unlike anything which has been done before. A little consideration will show how absurdly groundless this idea is. Why should it be necessary to produce something quite new, when, to use an old aphorism, "There is nothing new under the sun"? If we think for a moment, we shall find that the things we love best are those with which we are most familiar. That which lies outside our previous experience, which is presented to us for the first time, often makes little, if any, appeal, because we have nothing with which to associate it. It has been outside our mental vision, and until we have grown familiar with it, it seems strange and unapproachable.

An old thought in a new guise possesses at once the

charm of novelty and familiarity. This new guise is most suitably provided by the personality of the artist, author, or craftsman who presents, or represents the thought. Originality is really personality. Consequently the best method of approach to our subject is by way of familiar things. The easier we can make design appear, the more readily will the children grasp it, and utilize it as a means of expression. In *Drawing, Design, and Craftwork* I have suggested the use of common numerals arranged to form border designs. In *Design and Composition* I have introduced lettering in a similar manner, because both of these are conventionalized by long usage, and are familiar to most. It matters not one iota what elements we commence with provided they are simple and well known.

Personality.

Numerals.

Letters.

The first ornament of which we know anything was produced by the potter of prehistoric times with dots and strokes, incised with a pointed stick, upon the plastic clay he was using for his pot. We can imagine this primitive craftsman, after he had made a pot for his use, looking at it and wondering how he could make it more interesting, more beautiful, if such a thing as beauty entered into his mind at all. At any rate the creative instinct, having produced that which was calculated to fulfil a particular purpose, still craved for something more, for a more complete expression of itself. Consequently it led to the addition of ornament, superabundant, useless ornament, according to the pure utilitarian. But it satisfied a desire, an urge towards something higher than sheer utility, and it is this which has produced the best in the arts and crafts all down through the ages.

Primitive Decoration.

This desire is just as insistent to-day as it has been in any age, and it is felt by the child as strongly as, if not more so than by the adult. It would be interesting to know exactly how the prehistoric potter proceeded, how his ideas developed. Possibly he just scratched a line here, and another there, adding a dot now and then in a purely haphazard fashion, until in due course he developed pattern. Finding that order and rhythm

Desire for Beauty.

Rhythm.

Plate 90.

were more pleasing than disorder and a haphazard spotting, he ultimately evolved design. On the other hand it may have been that the innate desire for order and arrangement led directly to the patterns we know, without any preliminary floundering, but upon this point we cannot be sure. We only know that decoration exists upon the earliest known products of man's handiwork, and we know also that this pattern is composed of the simplest possible elements—dots and strokes.

Dots and Strokes.

If such was the beginning of ornament in the annals of the race, it would seem a suitable beginning for the individual member of the race. The child can easily make dots and strokes it puts no tax upon his powers, and there is little doubt that ordered spacing affords him interest and pleasure. The possibilities that lie within the scope of these simple elements for the production of pattern are far more numerous than would appear unless we have experimented with them. On Plate 90 will be seen a few arrangements of dots and strokes, some of the latter being vertical, some horizontal, and others oblique. Short strokes are varied with longer ones, and both with dots. Nothing would be simpler or more easily produced, yet by means of them we can make patterns. The mere repetition of these elements in an orderly rhythmic series evinces thought and arrangement in other words, a human origin.

Curves.

From lines to shapes is an easy step, and by filling in selected shapes, already bounded by lines we have drawn in our attempts to produce pattern, we arrive at still more definite pattern. Having to some extent exploited the possibilities of strokes, and shapes bounded by straight lines, we introduce curves. These are rather more difficult to draw, but if approached by easy stages, facility will soon develop. Some suggestions for curve combinations are given in Plate 90. Many others will occur as soon as we begin to experiment, and as far as possible the child should be encouraged to invent combinations and arrangements according to his own taste and fancy. The amount of suggestion or direction

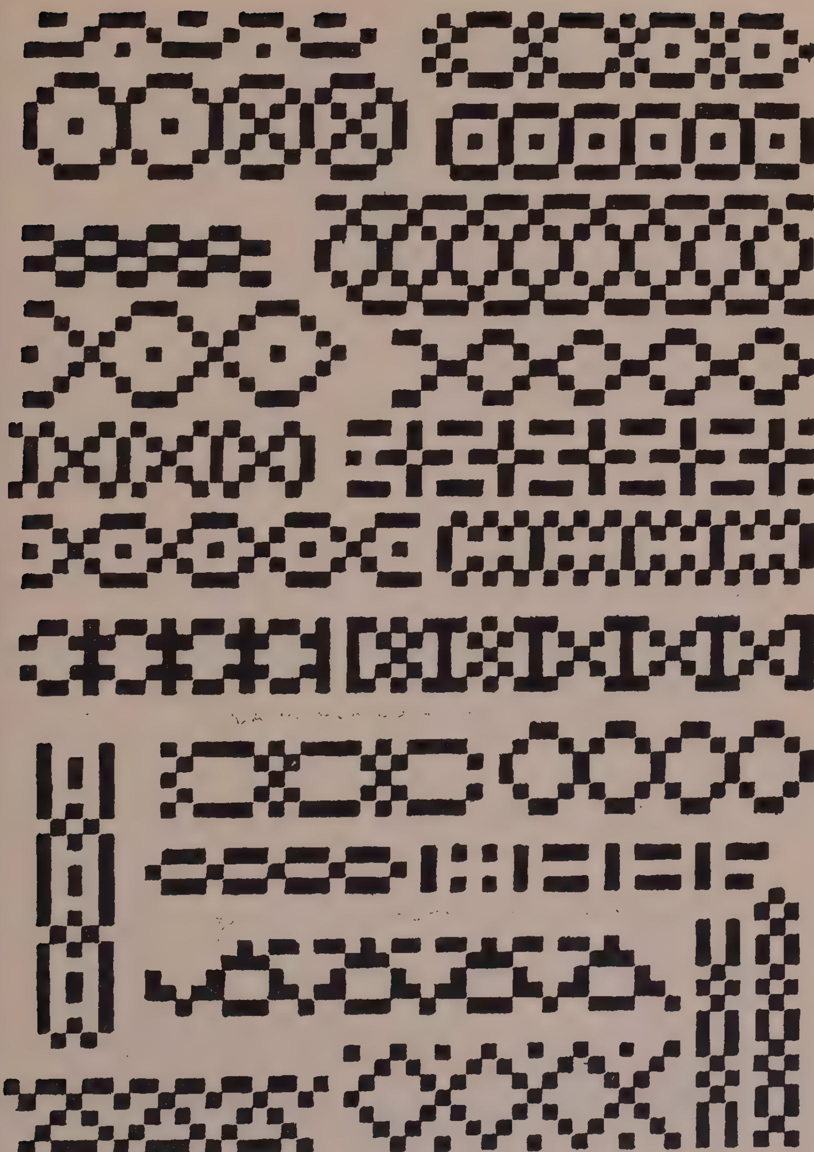


Plate 91.

to be given is a matter for the teacher to decide for himself. It will be more or less according to the capacity of the child.

Spots. The next stage might be the planning of self-contained units, or spots of design, again passing from the easiest forms to more difficult ones. Squares divided by diagonal lines and by lines parallel with the sides will suggest conventional flowers. A leaf simplified and adapted to a shape, while leaves and flowers, or leaves and fruit, can all be made to fit pleasantly into suitable shapes.

Motifs. Then other things which at first sight would seem less suitable, as trees, ships, houses, pots or metal objects, and more complex floral arrangements might be attempted. These exercises are valuable in many ways. They teach the pupils to analyse things, and to seize such essentials as will convey an idea of the thing employed as a *motif* within the limitations of the space. It is a sort of epitome, an idea used as a theme for an essay in "visual music."

Design Basis. Pattern, design, beauty in fact, is the primary consideration; the thing represented is of secondary importance. Representation or resemblance to natural forms, or other forms for that matter, is quite subsidiary to design. The children should be taught to appreciate this difference between pattern and representation, for herein lies one of the secrets of good design. The pleasant filling of the shape is the desired goal.

Plants. It is doubtful whether they should be allowed to draw from plants or other forms in the early stages, as it requires considerable skill and knowledge to appreciate the design which lies at the root of all nature's productions, so infinitely are they varied. The accidental is apt to appear of greater import than the fundamental or basic type. Hence it would seem wiser to evolve pattern by a thoughtful breaking up of shapes, or by using forms which have already been conventionalized.

Line and Proportion. First of all, inculcate an appreciation of harmonious line, and of pleasing proportions and shapes. When this has been grasped, nature's storehouse can be ransacked for inspiration and material. The danger lies

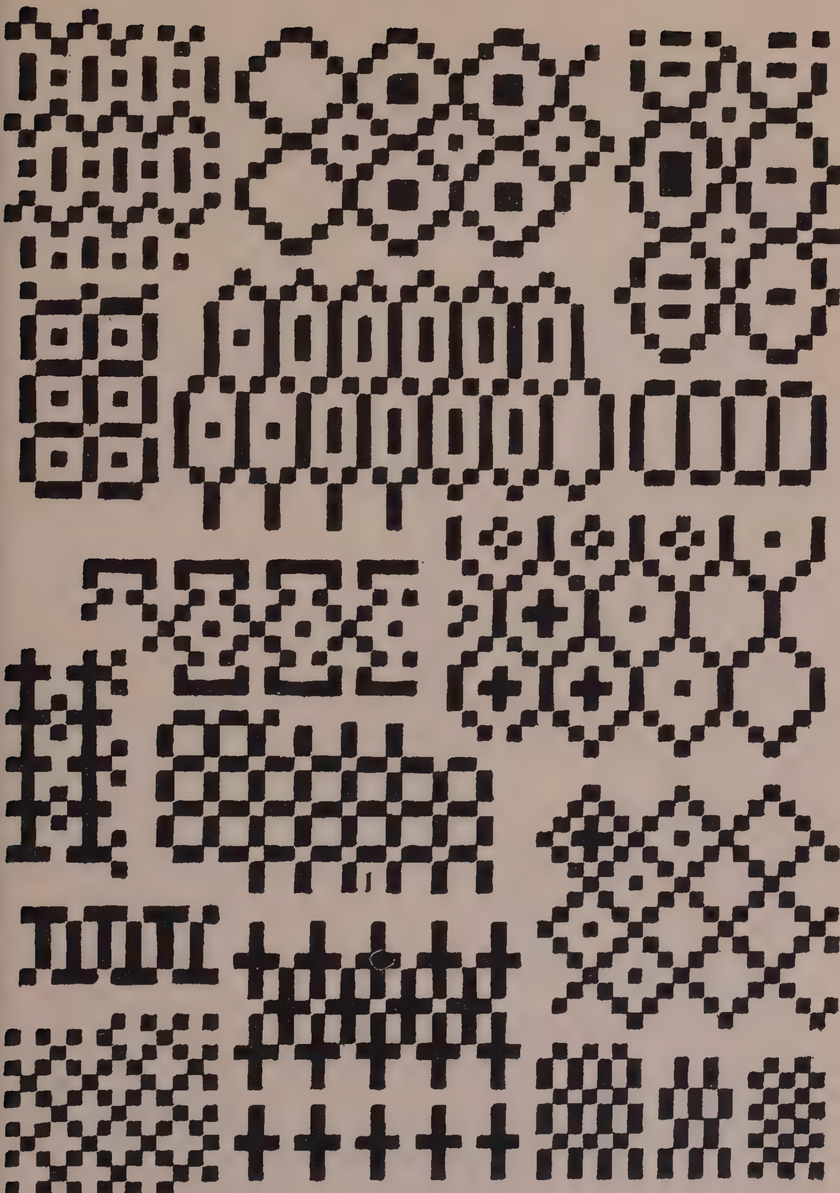


Plate 92.

in attempting too much at once. Nature is very charming in her handiwork, and unless we have schooled our minds to the task of design, we are in danger of forgetting all except the desire to reproduce the forms before us, even though the desire to achieve beauty, harmony, visual music, or whatever else we like to call it, is urgent and universal.

Squared Paper. Squared paper forms an excellent basis for pattern design, and the possible patterns are practically unlimited. A few of these are illustrated in Plates 91–92. After a few suggestions from the teacher as to the method of procedure, the children should be left to evolve patterns for themselves. A brush or a broad pen such as that used for lettering with ink, or a dark water colour should be used for defining the shapes. Here again the principles are ordered spacing, repetition, and rhythm. Proportion is an important factor in every form of design. Every object which man devises must first be designed or thought out, and the relationship of one part to another, and of each part to the whole, determines its appearance, good or bad.

Proportion. The most pleasing proportions are generally those which are unequal. Variety is more interesting and stimulating than monotony or equality. On the other hand too great a variety is apt to become restless and disconnected. Consequently variety with unity is the effect to be aimed at. The principle of domination is perhaps the best term that we can apply here. This means that in each case there is one dominant proportion, form, space, or other feature to which all others are in subordination.

A few illustrations will best serve to make this clear. In Plate 93 will be seen some articles which have been treated in different ways with a view to showing the greater interest which lies in variety. There is no need to enlarge upon this as it is obvious enough, but the teacher, by exhibiting examples or illustrations before the class, and discussing them with the scholars, can help to inculcate taste and discrimination. The illustrations

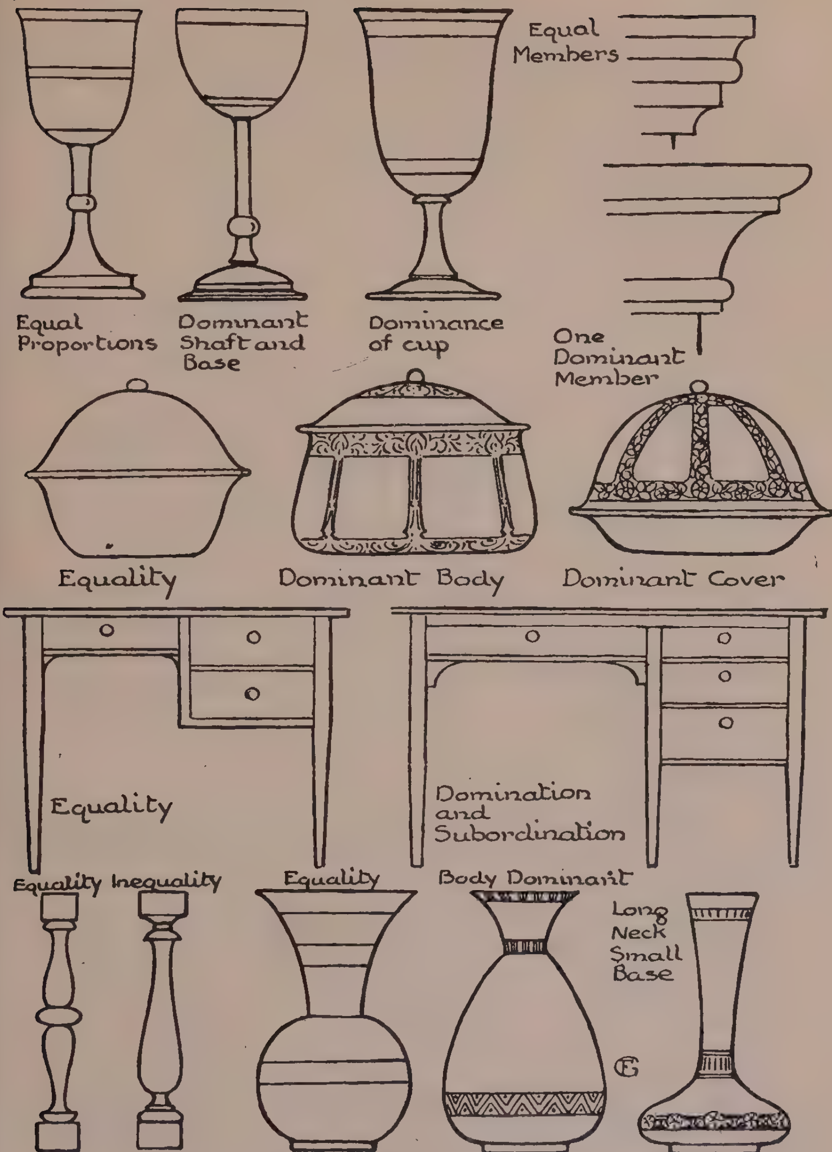

Equal Proportions
Dominant Shaft and Base
Dominance of cup
Equal Members
One Dominant Member
Equality
Dominant Body
Dominant Cover
Equality
Domination and Subordination
Equality Inequality
Equality
Body Dominant
Long Neck Small Base

PLATE 93.

should be chosen so that both good and bad examples may be seen and examined. The children should be encouraged to apply the principles they have learned to the objects about them, and to suggest improvements or alterations. In this way the analytical and critical faculties are developed, and in the days to come their attitude towards the things which form their environment will be thoughtful and questioning, instead of passively acceptant. This question of proportion or domination is important and the time spent in studying it is time well spent.

Spots of Decoration. Fig. 94 shows some simple decoration motifs a little more elaborate than those previously seen. Four of these spots are symmetrical while the rest are balanced but unsymmetrical. The children should be encouraged to design little *motifs* of this type, as they are useful for many of the exercises undertaken, while they help to develop facility in design. It is a good plan to collect the best examples of this type which can be obtained, in order that the children may be stimulated and inspired by them. Much charming work has been done, and is still being done, for magazine, book, and periodical decoration, and also for advertising purposes, and each is as much the expression of a thought or idea as the printed page it decorates.

Design is a vast subject, altogether too big to be dealt with here. We return to the subject from time to time when treating of the various crafts which come within our purview. I have dealt more fully with the matter in *Drawing, Design, and Craftwork* and *Design and Composition.*

Stencilling

Stencilling. Stencilling is a method whereby pattern can be produced and reproduced quite easily. It is an excellent way of decorating fabrics, papier mâché articles, book-covers, etc., while for border or repeating patterns it is particularly suitable. The chief thing to be considered when planning a stencil design is the binding or "tying"

together of the component parts. It is usual to cut the pattern shapes from the plate, while the background

FIG. 94.

(which surrounds and defines the shapes) remains to form the stencil plate. Hence it is easily seen that unless the various parts are knit together with "ties" the plate will fall to pieces. The safest plan is to choose simple

"Ties."

shapes, and to arrange that each one is surrounded by the paper, card or other material from which the stencil is cut. Plate 95 gives a few easy designs and patterns suitable for stencilling. A stout cartridge is as good as anything for the plates, especially if given a coating of linseed oil, knotting, or shellac.

Cutting. The knife should have a sharp point and the cutting be done upon a sheet of glass or cardboard. Glass gives a clean edge but soon blunts the knife, cardboard also gives a clean edge, and is kinder to the knife, but it spoils the cardboard for any other purpose. When the plate is cut it should be fastened into position upon the fabric or whatever it is we are decorating, either with drawing-pins, or an adhesive, as paste, gum, etc. It is wiser to fix it, as otherwise it may slip, and spoil the design.

Printing. The pattern is printed by dabbing colour through the spaces with a suitable brush, i.e. one which is close and firm, with the bristles all cut to one level instead of tapering to a point as is usually the case. Care is needed in applying the colour, which should not be too fluid, as it tends to spread beneath the plate, slurring the edges and spoiling the shapes in the pattern. *Oil Colour.* Oil colour is useful for stencilling. If the colour is too thin, the superfluous oil can be soaked up with blotting paper, or the colour allowed to stand for a while. *Water Colour.* Water colour in tubes, stains, and even dyes for fabrics can be employed with the stencil plate provided the brush is sufficiently dry to prevent the colour (or the vehicle which contains it) from spreading. Sometimes when oil colour has been used and no precaution taken, an unsightly margin of oil appears round the design.

Natural Forms. The study of natural forms lies somewhat outside the scope of this book. I have dealt with them in *Drawing, Design, and Craftwork* and in *Design and Composition*, but in our consideration of Industrial Art we might well compare the shapes of manufactured articles with those of nature where such comparisons can be instituted. There is no reason for supposing that a bowl or a saucer, or even a bell owes its shape to flowers. They were

PLATE 95.

probably evolved to serve the purposes for which they are intended, but despite this, it is quite possible that some modifications of form may have been brought about by designers who have studied nature. However this may be, the interest lies rather in the fact that similar forms do exist in nature and in the handiwork of man.

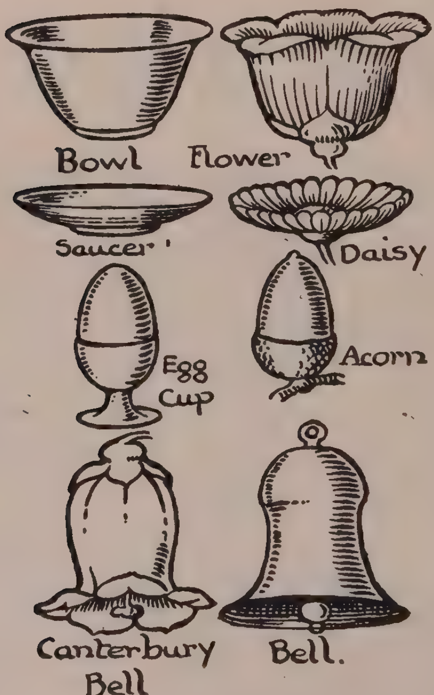


Fig. 96.

In fact nature usually gets there first, and whatever form we may chance to evolve in our efforts to design we generally find that she has forestalled us. Fig. 96 shows a few instances of similarity in form, which may suggest further enquiry into the subject, which is fascinating and likely to appeal to the child. Any means whereby interest may be added to the lesson should be at least considered, as the child learns most when most interested.

Using Natural Forms in Design.

Another interesting exercise is to take a plant such as the apple and to consider its possibilities as decorative material. Stencilling necessitates simplification of form to such an extent that little but the essentials are left. Fig. 97 illustrates the treatment of leaf, flower and fruit. The first is a simple leaf with a mid-rib only. No. 2 has veins in addition to the mid-rib. Nos. 3 and 4 are renderings of the fruit; 5, 6 and 7 show the treatment of flowers and joints. No. 8 is a simple spot of decoration

and No. 9 a border of leaves and fruit. Exercises of this type will inculcate an appreciation of the decoration which is applied to so many of the articles which go to the make-up of our modern environment.

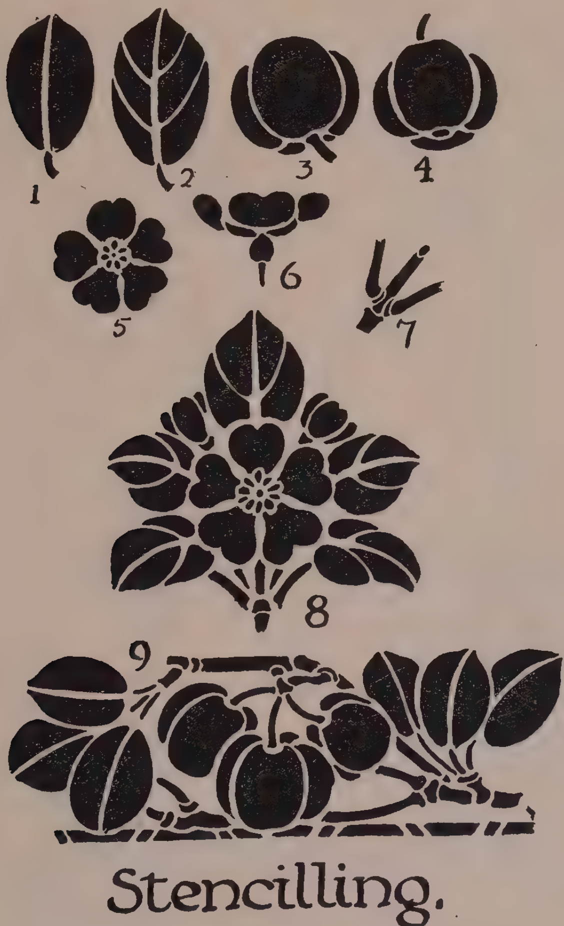


Fig. 97.

Fig. 98 shows a study of the thistle, together with a conventional rendering to illustrate how it may be used in design. It is an example of naturalistic as opposed to conventional treatment. Fig. 99 shows two bird forms

drawn direct with the brush, a method of decoration particularly adapted to pottery, papier mâché or other work calling for brush treatment.

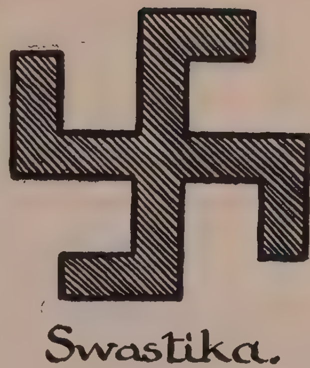
Other interesting subjects may be found under this

Fig. 98.

Fig. 99.

heading of design, in fact the whole of the matter that we have dealt with in this book resolves itself fundamentally into design. Nothing can be made unless it is first planned, thought out, and designed. In this section we are considering design from the standpoint of decora-

tion. It is not so much the design and evolution of an article as the outcome of a particular need, and the correct use of tools and materials to meet that need. It is the study of principles and rules of design as applied to pattern and decoration. Heraldry and other forms of symbolic ornament are worth considering.



Symbol.

FIG. 100.

Symbols are always fascinating because of the thought which lies behind the form. Ideas which cannot be adequately expressed can be suggested by means of symbols. The swastika (Fig. 100), is an ancient symbol adopted by man to suggest the sun. The sun to primitive man must have seemed a wonderful power, more potent even than we know it to be to-day. Doubtless he realized to some extent how much his comfort and welfare depended upon this source of light and heat. But how would he express what he felt? His language was very limited, his means of expression elementary, and so he invented a symbol, which suggested something of that which to him was quite inexpressible.

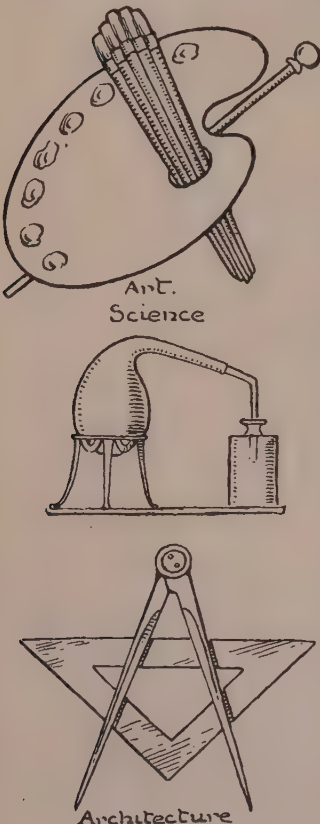


FIG. 101.

Many other symbols have been invented since the swastika. Religious expression has depended to an enormous extent upon symbolism. In fact all abstract ideas have found partial expression in this manner, because they defy definition, and can only be suggested. Symbols are much in use to-day in the form of trade marks, signs, badges and seals of societies, bodies,

FIG. 102.

corporations, etc. Fig. 101 shows the symbols of Architecture, Art, and Science. There are innumerable others which might be gathered together and discussed in the class. Heraldry is yet another form of symbolism. Fig. 102 is a lion rampant, gules or red upon a shield of gold, the colour and metal being symbolized by the vertical strokes and the dots. Heraldry is a subject full of interest and historic value.

CHAPTER XIV

TREES

Trees we have already touched upon in connexion with furniture, but they are worthy of consideration from other points of view. Wood we have seen is used for many purposes, and the children might well be taught to recognize the various species and to differentiate between the timbers, and the trees from whence they come. Every tree has its own characteristic form, mainly dependent upon the species to which it belongs, but also to a lesser degree upon the conditions of its growth. Each species is marked by its own peculiar foliage, bark and branching. By these it can be distinguished from other species.

Fig. 103 shows an oak together with leaves and acorns, all characteristic of the oak family. It is vigorous in growth, with gnarled, twisting branches, which mark it off quite distinctly from other families. It grows well in England, and has been adopted as a sort of symbol of the characteristics of the English people, largely no doubt because it was used in older days for ship building, and consequently played a very important part in the maritime exploits of the nation. Its wood is tough and durable, is excellent for carving, and figures largely in Gothic work and in fact the work of all periods, both constructional and decorative. *Oak.*

The larch (Fig. 104) is a coniferous or cone-bearing tree, which has long needle-like leaves, instead of lanceolate, spatulate, palmate or other form such as we see on the rest of our English trees. The wood from the larch is not so hard or so valuable as that yielded by the oak. It is made to serve other less important purposes. *Larch.*

Most of the coniferous trees are resinous, and are also evergreens, retaining their foliage throughout the year, while the deciduous trees shed their foliage in the autumn.

FIG. 103.

Elm. The elm (Fig. 105) is another characteristic English tree which in some parts of the country grows to an enormous height. It is one of the most beautiful of our trees, and is a decided feature in English landscape.

It is usually crowned with a beautiful fan-like growth, spreading beyond the lower branches and foliage. Its

FIG. 104.

wood is not unlike oak, though it has a tendency to warp more readily, but is a good material for use in damp places as it resists moisture better than most timbers.

The lime (Fig. 106) is notable during the early part *Lime.*

of the year for its sweet-smelling blossom, the odour of which attracts the bees, so that in their search for honey they may carry the pollen from the male to the female

Elm-tree

Fig. 105.

flower in order that it may become impregnated. The lime yields a fairly close-grained wood, not so hard as oak or elm. It is an excellent wood for carving and was much used by Grinling Gibbons, for whose dexterous

workmanship this smooth-grained, easily cut material was eminently suitable.

Fig. 106.

Willow. The willow (Fig. 107) is largely used for basket weaving and for cricket bats. In order to make it branch out into suitable long straight rods for basket weaving, the head is cut away, in other words the tree is "pollarded."

Willow-tree

Fig. 107.

It grows in moist places, and is generally to be found fringing the banks of stream or river. It is used for water wheels, steamboat paddles, and such purposes.

Lombardy Poplar. The Lombardy poplar (Fig. 108) is a tall, slender, tapering tree which produces a soft whitish wood suitable for rails and fences.

Sycamore. The sycamore (Fig. 109) is interesting because of its winged seeds, which when ripe fall from the tree and descend to the earth at some distance from the tree itself, owing to the wings which cause the seed to spin rapidly and so propel it on its journey. Its wood is somewhat hard, and is used considerably for turning, and for such purposes as rollers for wringing machines. Sycamore wood was used in ancient Egypt for mummy cases.

FIG. 108.

There is no gainsaying the fact that trees are amongst the most useful of nature's products, while few would dare to deny their beauty. The manifold purposes for which they are used in the industrial arts is sufficient excuse for a further study of trees. A knowledge of the characteristic features of some of the

commoner trees will certainly add to the interest of any excursions that may be taken into the country. A wood, a copse, or a forest is always a delightful place,

FIG. 109.

even to those who have no particular affection for trees. For the child there is always a mysterious charm, tinged with a touch of awe perhaps, about the dim twilight of a forest glade. It is quite easy for him to imagine

giants, wild animals, fairies, or knights in armour, haunting the deep umbrageous shadows of the woods.

The Greeks associated dryads, fauns, satyrs, and the

Robin Hood

FIG. 110.

great god Pan himself with tree-clad districts. In England we have many legends and stories about trees. Sherwood Forest is rarely mentioned without calling up visions of Robin Hood (Fig. 110) and his merry men,

clad in Lincoln green, while the New Forest is always connected with William Rufus slain by a glancing arrow launched by William Tyrrell. Legend, romance and history may be traced through the paths of the forests which in bygone days were far more dense and wide-spread than they are to-day.

Surely there is enough interest and stimulus to thought and investigation in trees to warrant their study in the class. The innumerable articles made from wood, and the multifarious purposes for which it is employed, will furnish considerable material for discussion, also the varieties of wood, and the purposes for which they are suitable. From these things it is but a short step to the tree from whence the wood is obtained, and so to the romantic story of its growth from a small seed to a huge towering structure of roots, bole, branches, twigs and foliage. The value of trees to the community, their beauty in the landscape, and the harbourage they afford to birds, are all worthy of consideration.

It may seem that we have departed somewhat from our theme of Industrial Art, but in any comprehensive scheme of education it is impossible to confine our subjects in watertight compartments. Thought once stimulated flows out in all directions, and any subject can be so treated as to embrace many others. In this manner we would advocate the teacher to treat this subject of Industrial Art. From the tangible article, tool, or material, we carry our investigations along the innumerable paths which open out from them. The lessons are rendered more concrete by actual work in the various branches under consideration, while the training afforded for hand, brain, muscle and eye by these exercises cannot fail to be of incalculable value to the scholar.

We can only hope that the methods here advocated will be more widely and universally adopted, and that the teacher will find in this volume sufficient suggestion upon which to build a scheme of education absorbingly interesting to himself and his pupils. We who believe

in these matters are convinced that only by the association of handwork with brainwork, and by the thoughtful consideration of the common things of everyday life, combined with a keen interest in art, craft, and industry generally, can we hope to produce a generation of contented, and at the same time skilled and interested people. There is undoubtedly a dignity in labour which far outweighs any that may accrue from the possession of wealth, while the skilled craftsman is the happiest of all men, because he is keenly interested in the work he is doing. All work is service to the community, and the man who can be happy in the service of his fellows is on the high road to being a contented, efficient, and valuable citizen.

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